

**US Army Corps  
of Engineers**  
Louisville District

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# **Solicitation for**

## **Vehicle Maintenance Shop Phase II Fort Campbell, Kentucky**

**22 July 1998**

**SFB DACA27-98-B-0028**

# USACE CONSTRUCTION CONTRACT FORMAT

DIVISION	SECTION	TITLE
0		Bidding Requirements, Contract Forms, and Conditions of the Contract
	00010	Solicitation/Contract Form (1442) Bid Schedule
	00105	Instructions to Bidders
	00605	Representations, Certifications, and Other Statements of Bidders (Sealed Bid)
	00700	Contract Clauses
	00800	Special Contract Requirements
1		General Requirements
2 thru 16		Technical Provisions

<b>SOLICITATION, OFFER, AND AWARD</b> (Construction, Alteration, or Repair)	1. SOLICITATION NO. DACA27-98-B-0028	2. TYPE OF SOLICITATION <input checked="" type="checkbox"/> SEALED BID (IFB) <input type="checkbox"/> NEGOTIATED	3. DATE ISSUED 22 July 1998	PAGE OF PAGES 1 of 5

**IMPORTANT - The "offer" section on the reverse must be fully completed by offeror.**

4. CONTRACT NO.		5. REQUISITION/PURCHASE REQUEST NO. W22W9K-8175-3808	6. PROJECT NO.
7. ISSUED BY  U.S. Army Engineer District, Louisville Corps of Engineers 600 Dr. Martin Luther King, Jr. Place Louisville, Kentucky 40202-2230	CODE	8. ADDRESS OFFER TO  U.S. Army Engineer District, Louisville Corps of Engineers 600 Dr. Martin Luther King, Jr. Place Louisville, Kentucky 40202-2230	
9. FOR INFORMATION CALL:	A. NAME See Instructions	B. TELEPHONE NO. (Include area code) <b>(NO COLLECT CALLS)</b> See Instruction	

**SOLICITATION**

NOTE: In sealed bid solicitations "offer" and "offeror" mean "bid" and "bidder."

10. THE GOVERNMENT REQUIRES PERFORMANCE OF THE WORK DESCRIBED IN THESE DOCUMENTS (Title, identifying no., date):

**VEHICLE MAINTENANCE SHOP, PHASE II, FT. CAMPBELL, KENTUCKY**

Construct two high bay vehicle maintenance buildings of approximately 12,500 SF each, with 7 ½ ton bridge crane and center 2-story admin area. Construct special material storage building with administrative areas of approximately 22,700 SF. These buildings will be slab-on-grade, insulated metal panel and double wythe masonry walls, standing seam metal roof and CMU and gypsum board interior. Storage buildings totaling 13,300 SF are preengineered metal buildings. Hardstand consists of 38,000 SY of concrete pavement and asphalt POV parking. Supporting facilities include utilities, communications system, fencing, storm drainage. HVAC is self-contained gas fire boiler and air cooled DX.

The estimated cost range of this project is from \$5,000,000 to \$10,000,000.

**BID MODIFICATIONS RECEIVED BY FACSIMILE OR TELETYPE WILL NOT BE CONSIDERED.**

AWARD IS BEING MADE PURSUANT TO THE SMALL BUSINESS COMPETITIVENESS DEMONSTRATION PROGRAM. (THIS PROCUREMENT HAS NO BUSINESS SIZE RESTRICTIONS.)

DEFENSE PRIORITY AND ALLOCATION REQUIREMENTS (SEP 1990) FAR 52.211-14: This is a rated order certified for national defense use, and the Contractor shall follow all the requirements of the Defense Priorities and Allocations System regulation (15 CFR 700), PRIORITY RATING: DO-C2

11. The Contractor shall begin performance within 10 calendar days and complete it within \*\* calendar days after receiving ☐ award, ☒ notice to proceed. This performance period is ☒ mandatory, ☐ negotiable. (See \*\*Section 00800, Para 4.)

12A. THE CONTRACTOR MUST FURNISH ANY REQUIRED PERFORMANCE AND PAYMENT BONDS? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	12B. CALENDAR DAYS 10
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## 13. ADDITIONAL SOLICITATION REQUIREMENTS:

- A. Sealed offers in original and 2 copies to perform the work required are due at the place specified in Item 8 by 3:00 p.m. (hour) local time 25 Aug 1998 (date). If this is a sealed bid solicitation, offers must be publicly opened at that time. Sealed envelopes containing offers shall be marked to show the offeror's name and address, the solicitation number, and the date and time offers are due.
- B. An offer guarantee ☒ is, ☐ is not required.
- C. All offers are subject to the (1) work requirements, and (2) other provisions and clauses incorporated in the solicitation in full text or by reference.
- D. Offers providing less than 60 calendar days for Government acceptance after the date offers are due will not be considered and will be rejected.

**OFFER (Must be fully completed by offeror)**

Page 2 of 5

14. NAME AND ADDRESS OF OFFEROR (Include ZIP Code)

15. TELEPHONE NO. (Include area code)

DUNS #

16. REMITTANCE ADDRESS (Include only if different than Item 14)

TIN #

CODE

FACILITY CODE

17. The offeror agrees to perform the work at the prices specified below in strict accordance with the terms of this solicitation, if this offer is accepted by the Government within 60 calendar days after the date offers are due. (Insert any number equal to or greater than the minimum requirement stated in Item 13D. Failure to insert any number means the offeror accepts the minimum in Item 13D.

AMOUNTS

Bidders shall show his prices on the Bid Schedule of this section.

18. The offeror agrees to furnish any required performance and payment bonds.

**19. ACKNOWLEDGMENT OF AMENDMENTS**

The offeror acknowledges receipt of amendments to the solicitation -- give number and date of each

AMENDMENT NO.

DATE

20A. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER (Type or print)

20B. SIGNATURE

20C. OFFER DATE

**AWARD (To be completed by Government)**

21. ITEMS ACCEPTED:

22. AMOUNT

23. ACCOUNTING AND APPROPRIATION DATA

24. SUBMIT INVOICES TO ADDRESS SHOWN IN  
(4 copies unless otherwise specified) Will be identified in  
Delegation letters.ITEM: Sec  
Para. 30

25. OTHER THAN FULL AND OPEN COMPETITION PURSUANT TO

☐ 10 U.S.C. 2304(c)( ) ☐ 41 U.S.C. 253(c)( )

26. ADMINISTERED BY CODE

U.S. Army Engineer District, Louisville  
Corps of Engineers, P.O. Box 59  
Louisville, KY 40201-0059

27. PAYMENT WILL BE MADE BY

USACE Finance Ctr. (UFC)  
7800 Third Avenue EFT:T  
Millington, TN 38054-5005**CONTRACTING OFFICER WILL COMPLETE ITEM 28 OR 29 AS APPLICABLE**

☐ 28. NEGOTIATED AGREEMENT (Contractor is required to sign this document and return        copies to issuing office.) Contractor agrees to furnish and deliver all items or perform all work, requisitions identified on this form and any continuation sheets for the consideration slated in this contract. The rights and obligations of the parties to this contract shall be governed by (a) this contract award, (b) the solicitation, and (c) the clauses, representations, certifications, and specifications or incorporated by reference in or attached to this contract.

☐ 29. AWARD (Contractor is not required to sign this document.) Your offer on this solicitation is hereby accepted as to the items listed. This award consummates the contract, which consists of (a) the Government solicitation and your offer, and (b) this contract award. No further contractual document is necessary.

30A. NAME AND TITLE OF CONTRACTOR OR PERSON AUTHORIZED TO SIGN  
(Type or print)

31A. NAME OF CONTRACTING OFFICER (Type or print)

30B. SIGNATURE

30C. DATE

31B. UNITED STATES OF AMERICA

31C. AWARD DATE

BY

Computer Generated

STANDARD FORM 1442 BACK (REV. 4-85)

ALL BIDDERS READ THE FOLLOWING INSTRUCTIONS

1. Each bidder shall, upon request of the Contracting Officer, furnish a list of the plant available to the bidder and proposed for use of the work.
2. Bidders are cautioned that drawings may not be reproduced to exact scale. All drawings, whether full size or reduced, should be checked for potential discrepancies, dimensions and scales should be verified and all drawings compared.
3. Bidders are required to acknowledge receipt of all amendments to this solicitation on Standard Form 1442 in the space provided, by completing Blocks 8 and 15 of the Amendment Form (SF 30), by separate letter, or by telegram prior to opening of bids. Failure to acknowledge all amendments may cause rejection of the bid/proposal.

NOTE: The Louisville District Office does not have it's own teletype. The bidder must insure that acknowledgment of any of any amendments by telegram will be physically delivered (telephone delivery is not acceptable) and received by the Government prior to the time set for opening of bids.

NEITHER FACSIMILE NOR TELEGRAPHIC BIDS ARE AUTHORIZED!!

# **CAUTION TO BIDDERS**

**BEFORE SIGNING AND MAILING THIS BID, PLEASE  
TAKE NOTE OF THE FOLLOWING, AS FAILURE TO  
PERFORM ANY ONE OF THESE ACTIONS MAY CAUSE  
YOUR BID TO BE REJECTED.**

1. **AMENDMENTS.** Have you acknowledge receipt of ALL amendments?  
If in doubt as to the number of amendments issued, please contact our office.
2. **AMENDED BID PAGES.** If any of the amendments furnished amended  
bid pages, the amended bid pages must be used on submitting your bid.
3. **LATE BIDS.** Please refer to the Instructions section contained  
in this package.
4. **BID GUARANTEE.** If bid guarantee is required for this project,  
sufficient bid guarantee in proper form must be furnished with your bid for  
construction projects exceeding \$100,000.
5. **MISTAKE BID.** Have you reviewed your bid prices for possible errors  
in calculations or work left out?
6. **FAX MODIFICATIONS OF BIDS.** We do not permit modifications  
of bids by fax.

## SECTION 00010

22 June 1998

**CONTINUATION SHEET**

REFERENCE NO. DOCUMENT BEING CONTINUED

PAGE

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NAME OF OFFEROR OR CONTRACTOR

ITEM NO.	SUPPLIES/SERVICES	QTY	UNIT	UNIT PRICE	AMOUNT
	Vehicle Maintenance Shops, Phase II Ft. Campbell, Kentucky				
1	Building B	1			\$ _____
2	Building C	1			\$ _____
3	Building D	1			\$ _____
4	626 <sup>th</sup> Deployment Storage Building	1			\$ _____
5	85 <sup>th</sup> Deployment Storage Building	1			\$ _____
6	Site Work (except items covered by Additives 1 and 2)	1			\$ _____
	<b>TOTAL BASE</b>				\$ _____
	<u>Additives</u>				
A1	Additional gravel surfaces storage area, additional grading and drainage work, revised security fence alignment, and additional site utilities work as indicated on the drawings.	1			\$ _____
A2	Additional bituminous and gravel surfaced POV parking	1			\$ _____
	<u>Special Bid Conditions.</u> If a modification to a bid based on unit prices is submitted, which provides for a lump sum adjustment to the total estimated cost, the application of the lump sum adjustment to each unit price in the bid schedule must be stated. If it is not stated, the bidder agrees that the lump sum adjustment shall be applied on a pro rata basis to every unit price in the bid schedule.				

SECTION 00105

INSTRUCTIONS FOR SEALED BID CONTRACTS

2 Jan 96

1. SOLICITATION DEFINITIONS - SEALED BIDDING - (July 1987) FAR 52.214-1.

"Government" means United States Government. "Offer" means "bid" in sealed bidding. "Solicitation" means an invitation for bids in sealed bidding.

2. AMENDMENTS TO INVITATIONS FOR BIDS (DEC 1989) FAR 52.214-3.

(a) If this solicitation is amended, then all terms and conditions which are not modified remain unchanged.

(b) Bidders shall acknowledge receipt of any amendment to this solicitation (1) by signing and returning the amendment, (2) by identifying the amendment number and date in the space provided for this purpose on the form for submitting a bid, 3) by letter or telegram, or (4) by facsimile, if facsimile bids are authorized in the solicitation. The Government must receive the acknowledgment by the time and at the place specified for receipt of bids.

3. FALSE STATEMENTS IN BIDS (APR 1984) FAR 52.214-4.

Bidders must provide full, accurate, and complete information as required by this solicitation and its attachments. The penalty for making false statements in bids is prescribed in 18 U.S.C. 1001.

20 March 1997

4. SUBMISSION OF BIDS (FEB 1997) FAR 52.214-5 (Para. a-e only).

(a) Bids and bid modifications shall be submitted in sealed envelopes or packages, (unless submitted by electronic means).

(1) Addressed to: U.S. Army Engineer District, Louisville  
600 Dr. Martin Luther King, Jr. Place  
Room 821  
Louisville, Kentucky 40202-2230

(2) Showing the time specified for receipt, the solicitation number, and the name and address of the bidder.

(b) Bidders using commercial carrier services shall ensure that the bid is addressed and marked on the outermost envelope or wrapper as prescribed in subparagraphs (a)(1) and (2) of this provision when delivered to the office specified in the solicitation.

(c) Telegraphic bids will not be considered unless authorized by the solicitation; however, bids may be modified or withdrawn by written or telegraphic notice.

(d) Facsimile bids, modifications, or withdrawals will not be considered unless authorized by the solicitation.

(e) Bids submitted by electronic commerce shall be considered only if the electronic commerce method was specifically stipulated or permitted by the solicitation.



(f) Hand-carried bids shall be deposited in the depository located in Room 821, Federal Building, 600 Dr. Martin Luther King, Jr. Place, Louisville, Kentucky.

(g) Express mail bids shall be addressed as shown in Paragraph (a) (1) above, ATTN: CEORLCT/Hitner.

5. EXPLANATION TO PROSPECTIVE BIDDERS (APR 1984) FAR 52.214-6.

Any prospective bidder desiring an explanation or interpretation of the solicitation, drawings, specifications, etc., must request it in writing soon enough to allow a reply to reach all prospective bidders before the submission of their bids. Oral explanations or instructions given before the award of a contract will not be binding. Any information given a prospective bidder concerning a solicitation will be furnished promptly to all other prospective bidders as an amendment to the solicitation, if that information is necessary in submitting bids or if the lack of it would be prejudicial to other prospective bidders.

20 March 1997

6. LATE SUBMISSIONS, MODIFICATIONS, AND WITHDRAWALS OF BIDS (MAY 1997) FAR 52.214-7.

(a) Any bid received at the office designated in the solicitation after the exact time specified for receipt will not be considered unless it is received before award is made and it--

(1) Was sent by registered or certified mail not later than the fifth calendar day before the date specified for the receipt of bids (e.g., a bid submitted in response to a solicitation requiring receipt of bids by the 20th of the month must have been mailed by the 15th); or

(2) Was sent by mail (or telegram or facsimile, if authorized) or hand-carried (including delivery by a commercial carrier) if it is determined by the Government that the late receipt was due primarily to Government mishandling after receipt at the Government installation;

(3) Was sent by U.S. Postal Service Express Mail Next Day Service-Post Office to Addressee, not later than 5:00 P.M. at the place of mailing two working days prior to the date specified for receipt of bids. The term "working days" excludes weekends and U.S. Federal holidays; or

(4) Was transmitted through an electronic commerce method authorized by the solicitation and was received at the initial point of entry to the Government infrastructure not later than 5:00 p.m. one working day prior to the date specified for receipt of bids.

(b) Any modification or withdrawal of a bid is subject to the same conditions as in paragraph (a) of this provision.

(c) The only acceptable evidence to establish the date of mailing of a late bid, modification, or withdrawal sent either by registered or certified mail is the U.S. or Canadian Postal Service postmark both on the envelope or wrapper and on the original receipt from the U.S. or Canadian Postal Service. Both postmarks must show a legible date or the bid, modification, or withdrawal shall be processed as if mailed late. "Postmark" means a printed, stamped, or otherwise placed impression (exclusive of a postage meter machine impression) that is readily

identifiable without further action as having been supplied and affixed by employees of the U.S. or Canadian Postal Service on the date of mailing. Therefore, bidders should request the postal clerk to place a legible hand cancellation bull's-eye postmark on both the receipt and the envelope or wrapper.

(d) The only acceptable evidence to establish the time of receipt at the Government installation is the time/date stamp of that installation on the bid wrapper or other documentary evidence of receipt maintained by the installation.

(e) The only acceptable evidence to establish the date of mailing of a late bid, modification, or withdrawal sent by U.S. Postal Service Express Mail Next Day Service-Post Office to Addressee is the date entered by the post office receiving clerk on the "Express Mail Next Day Service-Post Office to Addressee" label and the postmark on the envelope or wrapper and on the original receipt from the U.S. Postal Service. "Postmark" has the same meaning as defined in paragraph (c) of this provision, excluding postmarks of the Canadian Postal Service. Therefore, bidders should request the postal clerk to place a legible hand cancellation bull's-eye postmark on both the receipt and the envelope or wrapper.

(f) Notwithstanding paragraph (a) of this provision, a late modification of an otherwise successful bid that makes its terms more favorable to the Government will be considered at any time it is received and may be accepted.

(g) Bids may be withdrawn by written notice or telegram (including mailgram) received at any time before the exact time set for receipt of bids. If the solicitation authorizes facsimile bids, bids may be withdrawn via facsimile received at any time before the exact time set for receipt of bids subject to the conditions specified in the provision entitled "Facsimile Bids." A bid may be withdrawn in person by a bidder or its authorized representative if, before the exact time set for receipt of bids, the identify of the person requesting withdrawal is established and the person signs a receipt for the bid.

(h) If an emergency or unanticipated event interrupts normal Government processes so as to cause postponement of the scheduled bid opening, and urgent Government requirements preclude amendment of the solicitation or other notice of an extension of the opening date, the time specified for receipt of bids will be deemed to be extended to the same time of day specified in the solicitation on the first work day on which normal Government processes resume.

#### 7. PREPARATION OF BIDS - CONSTRUCTION (APR 1984) FAR 52.214-18.

(a) Bids must be (1) submitted on the forms furnished by the Government or on copies of those forms, and (2) manually signed. The person signing a bid must initial each erasure or change appearing on any bid form.

(b) The bid form may require bidders to submit prices for one or more items on various bases, including -

- (1) Lump sum bidding;
- (2) Alternate prices;
- (3) Units of construction; or
- (4) Any combination of subparagraphs (1) through (3) above.

(c) If the solicitation requires bidding on all items, failure to do so will disqualify the bid. If bidding on all items is not required, bidders should insert the words "no bid" in the space provided for any item on which no price is submitted.

(d) Alternate bids will not be considered unless this solicitation authorizes their submission.

1 Aug 96

8. SUBMISSION OF OFFERS IN THE ENGLISH LANGUAGE (APR 1991) FAR 52.214-34

Offers submitted in response to this solicitation shall be in the English language. Offers received in other than English shall be rejected.

1 Aug 96

9. SUBMISSION OF OFFERS IN U.S. CURRENCY (APR 1991) FAR 52.214-35

Offers submitted in response to this solicitation shall be in terms of U.S. dollars. Offers received in other than U.S. dollars shall be rejected.

10. BIDDER'S QUALIFICATIONS.

Before a bid is considered for award, the bidder may be requested by the Government to submit a statement regarding his previous experience in performing comparable work, his business and technical organization, financial resources, and plant available to be used in performing the work. The successful bidders will be required to submit his Workman's Compensation Experience Modification Rate (EMR) for the previous 3 years.

11. NOT USED.

28 March 1998

12. BID GUARANTEE (SEP 1996) FAR 52.228-1 (Para. (a) - (e) only).

(a) Failure to furnish a bid guarantee in the proper form and amount, by the time set for opening of bids, may be cause for rejection of the bid.

(b) The bidder shall furnish a bid guarantee in the form of a firm commitment, such as a bid bond supported by good and sufficient surety or sureties acceptable to the Government, postal money order, certified check, cashier's check, irrevocable letter of credit, or, under Treasury Department regulations, certain bonds or notes of the United States. The Contracting Officer will return bid guarantees, other than bid bonds, (1) to unsuccessful bidders as soon as practicable after the opening of bids, and (2) to the successful bidder upon execution of contractual documents and bonds (including any necessary coinsurance or reinsurance agreements), as required by the bid as accepted.

(c) The amount of the bid guarantee shall be 20 percent of the bid price or \$3,000,000, whichever is less.

(d) If the successful bidder, upon acceptance of its bid by the Government within the period specified for acceptance, fails to execute all contractual documents or furnish executed bond(s) within 10 days

after receipt of the forms by the bidder, the Contracting Officer may terminate the contract for default.

(e) In the event the contract is terminated for default, the Bidder is liable for any cost of acquiring the work that exceeds the amount of its bid, and the bid guarantee is available to offset the difference.

(f) The Bid Bond penalty may be expressed in terms of a percentage of the bid price or may be expressed in dollars and cents. Bid bonds are not required for projects under \$100,000.

(g) Individual Sureties. See Paragraph 15.

20 March 1997

13. PERFORMANCE AND PAYMENT BONDS. After the prescribed forms are presented to the bidder to whom award is made for signature, a written contract on the form prescribed by the specifications shall be executed and two bonds, each with good and sufficient surety or sureties acceptable to the Government shall be furnished: a Performance Bond (Standard Form 25) and a Payment Bond (Standard Form 25A). The penal sums of such bonds will be as follows:

(a) Performance Bond. The penal sum of the performance bond shall equal one hundred percent (100%) of the contract price.

(b) Payment Bond.

(1) When the contract price is \$1,000,000 or less, the penal sum will be fifty percent (50%) of the contract price.

(2) When the contract price is in excess of \$1,000,000 but not more than \$5,000,000, the penal sum shall be forty percent (40%) of the contract price.

(3) When the contract price is more than \$5,000,000 the penal sum shall be \$2,500,000.

(c) For rules covering the use of individual sureties see Paragraph 15. Any bonds furnished will be furnished by the Contractor to the Government prior to commencement of contract performance.

14. NOT USED.

15. RULES FOR USE OF INDIVIDUAL SURETIES.

(a) One individual surety is adequate support for a bond, provided the unencumbered value of the assets pledged by that individual surety equal or exceed the amount of the bond. An offeror may submit up to three individual sureties for each bond, in which case the pledged assets when combined must equal or exceed the penal amount of the bond. Each individual surety must accept both joint and several liability to the extent of the penal amount of the bond.

(b) An individual surety may be accepted only if a security interest in acceptable assets is provided to the Government by the individual surety. The security interest shall be furnished with the bond, and may be provided by one or a combination of the following methods:

(1) An escrow account with a federally insured financial institution in the name of the contracting agency.

(2) A lien on real property, subject to restrictions contained herein.

(c) Acceptable assets include:

(1) Cash or certificates of deposit, or other cash equivalents with a federally insured financial institution;

(2) United States Government securities at market value;

(3) Stocks and bonds actively traded on a national U.S. security exchange with certificates issued in the name of the individual surety (these assets will be accepted at 90 percent of their 52 week low, as reflected at the time of submission of the bond);

(4) Real property owned in fee simple by the surety without any form of concurrent ownership (these assets will be accepted at 100 percent of the most current tax assessment value exclusive of encumbrances or 75 percent of the properties' unencumbered market value provided a current appraisal is furnished);

(5) Irrevocable letters of credit (ILC) issued by a federally insured financial institution in the name of the contracting agency and which identify the agency and solicitation or contract number for which the ILC is provided.

(d) Unacceptable assets include but are not limited to:

(1) Notes or accounts receivable;

(2) Foreign securities;

(3) Real property as follows:

a. Real property located outside the United States, its territories, or possessions.

b. Real property which is a principal residence of the surety.

c. Real property owned concurrently regardless of the form of co-tenancy except where all co-tenants agree to act jointly.

d. Life estates, leasehold estates, or future interests in real property.

(4) Personal property such as jewelry, furs, antiques;

(5) Stocks and bonds of the individual surety in a controlled, affiliated, or closely held concern of the Offeror/Contractor;

(6) Corporate assets (e.g., plant and equipment);

(7) Speculative assets (e.g., mineral rights);

(8) Letters of credit, except as provided in subparagraph c(5) above.

(e) With respect to the acceptance of real property, the individual



3 June 1998

17. REQUESTS FOR INFORMATION. Telephone inquiries relating to this procurement should be directed to the Louisville District, Corps of Engineers, as listed below: ORAL EXPLANATIONS OR INSTRUCTIONS GIVEN BEFORE THE AWARD OF A CONTRACT WILL NOT BE BINDING. SEE PARAGRAPH 5: "EXPLANATION TO PROSPECTIVE BIDDERS" FOR PROPER PROCEDURES.

Procurement of Plans

& Specifications--Diana Lewis.....502/625-7402

Prospective Bidders may find the planholders list on the Internet at

[http://www.orl/usace.army.mil/ceor11/ct\\_pages.htm](http://www.orl/usace.army.mil/ceor11/ct_pages.htm)

Bid Results--Connie Senne.....502/582-5706

Technical Questions on Plans

& Specifications shall be written and faxed to -

Bill Deane .....502/582-6763

18. LOCATION OF BID OPENING. Directions and map to the bid opening address are attached at the end of this section.

20 March 1997

19. AVAILABILITY OF SPECIFICATIONS LISTED THE IN GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (JUN 1997) FAR 52.211-1

(a) A single copy of each specification cited in this solicitation is available without charge from the GSA Federal Supply Service Bureau Specifications Section (3FBP-W), 470 East L'Enfant Plaza, SW., Suite 8100, Washington, D.C. 20407 (Tel. 202-619-8925). Additional copies may be purchased from the GSA Specifications Section in Washington, D.C.

(b) The GSA Index of Federal Specifications, Standards and Commercial Item Descriptions may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

28 March 1998

20. AVAILABILITY OF SPECIFICATIONS LISTED IN THE DOD INDEX OF SPECIFICATIONS AND STANDARDS (DODISS) (JUN 1997) FAR 52.211-2

(a) Single copies of specifications cited in this solicitation may be obtained by submitting a written request to the supply point listed below. The request must contain the title of the solicitation, its number, date, applicable amendment(s), and the solicitation or contract number. A telephone order entry system is available with the use of a touch tone telephone. A Customer Number is required to use this system and may be obtained in written request to the address listed below or by telephone (215-697-2179). In case of urgency, telegraphic requests are acceptable. Voluntary standards, which are not available to offerors and Contractors from Government sources, may be obtained from the organization responsible for their preparation, maintenance, or publication.

Standardization Documents

Order Desk, Building 4, Section D

700 Robbins Avenue

Philadelphia, PA 19111-5094

Fax Number 215-697-2978

Telephone Order Entry System

(TOES) Numbers 215-697-1187

through and including 215-697-1197

(b) Commercial Specifications, Standards and Descriptions. These specifications, standards and description are not available from Government sources. They may be obtained from the publishers.

20 March 1997

21. AVAILABILITY OF SPECIFICATIONS AND STANDARDS NOT LISTED IN DODISS, DATA ITEM DESCRIPTIONS NOT LISTED IN DOD 5010.12-L, AND PLANS, DRAWINGS, AND OTHER PERTINENT DOCUMENTS (DEC 1991) DFARS 252.211-7001

Offerors may obtain the specifications, standards, plans, drawings, data item descriptions, and other pertinent documents cited in this solicitation by submitting a request to:

As state in Paragraph 18.

Include the number of the solicitation and the title and number of the specification, standard, plan, drawings, or other pertinent document.

22. NOT USED.

2 Jan 96

23. INDUSTRY SMALL BUSINESS SIZE STANDARDS (NOV 1988) FAR 19.102.

23.1 General.

(a) The SBA establishes small business size standards on an industry-by-industry basis. These size standards are also set forth in SBA's regulations at 13 CFR 121.

(b) Small business size standards are applied by--

(1) Classifying the product or service being acquired in the industry whose definition, as found in the Standard Industrial Classification (SIC) Manual, best describes the principal nature of the product or service being acquired.

(2) Identifying the size standard SBA established for that industry; and

(3) Specifying the size standard in the solicitation, so that offerors can appropriately represent themselves as small or large.

(c) For size standard purposes, a product or service shall be classified in only one industry, whose definition best describes the principal nature of the product or service being acquired even though for other purposes it could be classified in more than one.

(d) When acquiring a product or service that could be classified in two or more industries with different size standards, contracting officers shall apply the size standard for the industry accounting for the greatest percentage of the contract price.

(e) If a solicitation calls for more than one item and allows offers to be submitted on any or all of the items, an offeror must meet the size standard for each item it offers to furnish. If a solicitation calling for more than one item requires offers on all or none of the items, an offeror may qualify as a small business meeting the size standard for



the item accounting for the greatest percentage of the total contract price.

(f) Any concern which submits a bid or offer in its own name, other than on a construction or service contract, but which proposes to furnish a product which it did not itself manufacture, is deemed to be a small business when--

(1) In the case of Government acquisitions set-aside for small businesses, such nonmanufacturer must furnish in the performance of the contract the product of a small business manufacturer or producer, which end product must be manufactured or produced in the United States. The term "nonmanufacturer" includes a concern which can manufacture or produce the product referred to in the specific acquisition but does not do so in connection with that acquisition. For size determination purposes there can be only one manufacturer of the end item being procured. The manufacturer of the end item being acquired is the concern which, with its own forces, transforms inorganic or organic substances including raw materials and/or miscellaneous parts or components into such end item. Whether a bidder on a particular acquisition is the manufacturer or a nonmanufacturer for the purpose of a size determination need not be consistent with whether such concern is or is not a manufacturer for the purpose of the Walsh-Healey Act.

(2) A concern which packages items and packages them into a kit is considered to be a nonmanufacturer small business and can qualify as such for a given acquisition if it meets the size qualifications of a small nonmanufacturer for acquisition, and if more than 50 percent of the total value of the kit and its contents is accounted for by items manufactured by small business.

(3) If the acquisition is subject to and is actually procured under "small purchase procedures," such nonmanufacturer may furnish any domestically produced or manufactured product.

(4) For the purpose of receiving a Certificate of Competency on an unrestricted acquisition, a small business nonmanufacturer may furnish any domestically produced or manufactured product. The applicable size standard shall be that of the wholesale industry of the item being acquired.

23.2 The industry size standards are set forth in the following table. The table column labeled "SIC" follows the standard industrial classification code as published by the Government in the Standard Industrial Classification Manual. The Manual is intended to cover the entire field of economic activities. It classifies and defines activities by industry categories and is the source used by SBA as a guide in defining industries for size standards. The number of employees or annual receipts indicates the maximum allowed for a concern, including its affiliates, to be considered small.

23.3 Size standards for construction and special trades.

A concern is small if its average annual receipts for its preceding 3 fiscal years did not exceed \$17 million. However, if 75 percent or more of the work (in terms of dollar value) called for by the contract is classified in one of the industries, subindustries, or classes of products listed in this paragraph, the concern is small if its average annual receipts for its preceding 3 fiscal years did not exceed the size

standard for that industry, subindustry, or class of products. (See Division C, "Contract Construction," of the SIC Manual).

Classification Code	Industry, Subindustry, or Class of Products	Size Standard*
------------------------	---	-------------------

MAJOR GROUP 15--BUILDING CONSTRUCTION--GENERAL CONTRACTORS  
AND OPERATIVE BUILDERS

1521	General Contractors--Single-Family House	\$17.0
1522	General Contractors--Residential Buildings, Other Than Single-Family	17.0
1531	Operative Builders	17.0
1541	General Contractors--Industrial Buildings and Warehouses	17.0
1542	General Contractors--Nonresidential Buildings Other Than Industrial Buildings and Warehouse	17.0

MAJOR GROUP 16--CONSTRUCTION OTHER THAN BUILDING  
CONSTRUCTION--GENERAL CONTRACTORS

1611	Highway and Street Construction, Except Elevated Highway	17.0
1622	Bridge, Tunnel, and Elevated Highway Construction	17.0
1623	Water, Sewer, Pipe Line, Communication and Power Line Construction	17.0
1629	Heavy Construction, Except Dredging N.E.C.	17.0
1629	Dredging and Surface Cleanup Activities	13.5

MAJOR GROUP 17--CONSTRUCTION--SPECIAL TRADE  
CONTRACTORS

1711	Plumbing, heating (except electric), and air conditioning	\$7
1721	Painting, paperhanging, and decorating	7
1731	Electrical Work	7
1741	Masonry, stone setting, and other stonework	7
1742	Plastering, drywall, acoustical and insulation work	7
1743	Terrazzo, tile, marble, and mosaic work	7
1751	Carpentering and flooring	7
1752	Floor laying and other floorwork, not elsewhere classified	7
1761	Roofing and sheet metal work	7
1771	Concrete work	7
1781	Water well drilling	7
1791	Structural steel erection	7
1793	Glass and glazing work	7
1794	Excavating and foundation work	7
1795	Wrecking and demolition work	7
1796	Installation or erection of building equipment, not elsewhere classified	7
1799	Special trade contractors, not elsewhere classified	7

\* (Average Annual Receipts) (Millions)

24. NOT USED.

2 Jan 96

25. ARITHMETIC DISCREPANCIES EFARS 52.214-5000.

(a) For the purpose of initial evaluations of bids, the following will be utilized in resolving arithmetic discrepancies found on the face of the bidding schedule as submitted by the bidder:

- (1) Obviously misplaced decimal points will be corrected;
- (2) In case of discrepancy between unit prices and extended price, the unit price will govern;
- (3) Apparent errors in extension of unit prices will be corrected; and
- (4) Apparent errors in addition of lump-sum and extended prices will be corrected.

(b) For the purposes of bid evaluation, the Government will proceed on the assumption that the bidder intends his bid to be evaluated on the basis of the unit prices, the totals arrived at by resolution of arithmetic discrepancies as provided above and the bid will be so reflected on the abstract of bids.

(c) These correction procedures shall not be used to resolve any ambiguity concerning which bid is low.

1 February 1995

26. WAGE RATES. The Wage Decisions of the Secretary of Labor are applicable to the work to be performed under this contract and are contained in SECTION 00800, SPECIAL CONTRACT REQUIREMENTS. Modifications are periodically made to the wage decisions. The complete modifications will be issued by amendment to the solicitation.

27. MODIFICATIONS PRIOR TO DATE SET FOR OPENING BIDS. The right is reserved, as the interest of the Government may require, to revise or amend the specifications and/or drawings prior to the date set for opening of bids. Such revisions and amendments, if any, will be announced by an amendment or amendments to this Invitation for Bids. Copies of such amendments as may be issued will be furnished to all prospective bidders. If the revisions and amendments are of a nature which require material changes in quantities or prices bid or both, the date set for opening bids may be postponed by such number of days as in the opinion of the District Engineer will enable bidders to revise their bids. In such cases, the amendment will include an announcement of the new date for opening bids.

28. NOTICE OF BUY AMERICAN ACT REQUIREMENT--CONSTRUCTION MATERIALS UNDER TRADE AGREEMENTS ACT AND NORTH AMERICAN FREE TRADE AGREEMENT (MAY 1997) FAR 52.225-13

(a) Offerors are required to comply with the requirements of Federal Acquisition Regulation (FAR) clause 52.225-15, Buy American Act--Construction Materials Under Trade Agreements Act and North American Free Trade Agreement, of this solicitation. The terms defined in FAR clause 52.225-15 have the same meaning in this provision.

(b) Offerors should request a determination regarding the inapplicability of the Buy American Act in time to allow determination before submission of offers. For evaluation of a request for a determination regarding the inapplicability of the requirements of the Buy American Act prior to the time set for receipt of offers, the information and applicable supporting data

required by paragraphs (c) and (d) of FAR clause 52.225-15 shall be included in the request. If an offeror has not requested a determination regarding the inapplicability of the Buy American Act prior to submission of its offer, or has not received a response to a request made prior to submission of its offer, the information and supporting data shall be included in the offer.

(c) Evaluation of offers.

(1) For evaluation of offers, (unless agency regulations specify a higher percentage) the Government will add to the offered price 6 percent of the cost of any foreign construction material proposed for exception from the requirements of the Buy American Act based on claimed unreasonable cost of domestic construction materials in accordance with paragraph (b)(4)(i) of FAR clause 52.225-15.

(2) If the evaluation of offers results in a tie between an offer including such foreign construction material excepted on the basis of unreasonable cost, as evaluated, and an offer including solely domestic construction material or other foreign construction material, listed in the solicitation at paragraph (b)(3) of FAR clause 52.225-15, or subsequently excepted in accordance with paragraphs (b)(4)(ii) or (iii) of FAR clause 52.225-15, award shall be made to the offeror that submitted the latter offer.

(d) Alternate offers.

(1) When an offer includes foreign construction material not listed by the Government in the solicitation at paragraph (b)(3) of FAR clause 52.225-15, offerors also may submit alternate offers based on use of equivalent domestic construction material.

(2) If alternate offers are submitted, a separate Standard Form 1442 shall be submitted for each alternate offer, and a separate price comparison table, prepared in accordance with paragraphs (c) and (d) of FAR clause 52.225-15, shall be submitted for each offer that is based on the use of any foreign construction material for which the Government has not yet determined an exception to apply.

(3) If the Government determines that a particular exception requested under paragraph (c) of FAR clause 52.225-15 does not apply, the Government will evaluate only those offers based on use of the equivalent domestic construction material, and the offeror shall be required to furnish such domestic construction material.

(i) In sealed bid procurements, any offer based on use of that particular foreign construction material shall be rejected as nonresponsive.

(ii) In negotiated procurements, any offer based on use of that particular foreign construction material may not be accepted unless revised during negotiations.

29. LISTING OF EMPLOYMENT OPENINGS. Offerors should note that this solicitation includes a provision requiring the listing of employment openings with the local office of the State employment service system if the award is for \$10,000 or more.

22 June 1998

30. SUBMISSION OF INVOICES.

In accordance with Section 00010, Para. 24, submit invoices to:

Ft. Campbell Area Office  
Bldg. 2180, 13 1/2 Street  
Ft. Campbell, Kentucky 42223-5356  
502-798-7222

31. NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY (APR 1984) FAR 52.222-23.

(a) The Offeror's attention is called to the EQUAL OPPORTUNITY and the AFFIRMATIVE ACTION COMPLIANCE REQUIREMENTS FOR CONSTRUCTION clauses of this solicitation.

(b) The goals for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

.....	
Goals for minority participation for each trade	Goals for female participation in each trade
18.2%	6.9%
.....	

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or Federally assisted) performed in the covered area. If the Contractor performs construction work (whether or not it is Federal or Federally assisted) in a geographical area located outside the covered area, it shall apply the goals established for the geographical area where such work is actually performed. Goals are published periodically in the Federal Register in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs (OFCCP) Office.

(c) The Contractor's compliance with Executive Order 11246 as amended and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity clause, specific affirmative action obligations required by the clause entitled "Affirmative Action Compliance Requirements for Construction" and its efforts to meet prescribed goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

(d) The Contractor shall provide written notification to the Director, OFCCP within 10 working days of award of any construction subcontract in excess of \$10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, Address and telephone number of the subcontractor, employer identification number of the subcontractor; estimated dollar amount of the

subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed.

(e) As used in this Notice, and in the contract resulting from this Solicitation, the "covered area" is Nashville, Tennessee economic area which includes Montgomery County, Tennessee.

2 Jan 96

32. SUBCONTRACTING PLANS FOR SMALL, SMALL DISADVANTAGED, AND WOMEN-OWNED SMALL BUSINESS CONCERNS. Bidders are cautioned that compliance with CONTRACT CLAUSE: SMALL, SMALL DISADVANTAGED, AND WOMEN-OWNED SMALL BUSINESS SUBCONTRACTING PLAN requires that the apparent low bidder, upon request by the Contracting Officer, submit a subcontracting plan for subcontracting with small, small disadvantaged, and women-owned small business concerns. Bidders desiring assistance in developing a source list are encouraged to contact small business, small disadvantaged, and women-owned small business associations and appropriate Offices of Small and Disadvantaged Business Utilization, addresses which may be obtained from the District Labor Adviser, U.S. Army Engineer District, P.O. Box 59, Louisville, Kentucky 40201 (Telephone 502/582-5679).

33. PERFORMANCE OF WORK BY CONTRACTOR. Attention is directed to SPECIAL CONTRACT REQUIREMENT: PERFORMANCE OF WORK BY CONTRACTOR. The apparent low bidder must furnish the Contracting Officer, within 5 working days after bid opening, a description of the work which he intends to perform with his own organization, e.g., earthwork, paving, brickwork, or roofing), the percentage of the total work this represents, and the estimated cost thereof.

15 September 1995

34. MODIFICATION OF BIDS BY FACSIMILE. Bidders WILL NOT be allowed to modify their bids at any time by facsimile or teletype.

35. PAYMENT FOR BOND PREMIUMS. CONTRACT CLAUSE: PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS provides that upon presentation of evidence of full payment, the Government will immediately reimburse the Contractor the cost of premiums for performance and payment bonds. This reimbursement amount is not in addition to the amount bid for the work covered by this Invitation for Bids, and bidders are cautioned to include the cost of such premiums in the bid items shown on the Bidding Schedule (or in the lump sum amount of the bid if no bid items are listed). If bond premiums are reimbursed under this clause, such reimbursed amount will be recovered by the Government from the progress payments made to the Contractor or, if no progress payments are made, from the amount otherwise due the Contractor upon final payment.

36. NOT USED.

37. NOT USED.

20 March 1997

38. SERVICE OF PROTEST (AUG 1996) FAR 52.233-2.

(a) Protests, as defined in Section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with the General Accounting Office (GAO) shall be served on the Contracting Officer (addressed as follows) by obtaining written and dated acknowledgment of receipt from:

Ms. Janet M. Henderzahs, Contracting Officer  
U.S. Army Engineer District, Louisville  
Corps of Engineers - ATTN: CEORLCT  
600 Dr. Martin Luther King Jr. Place, Room 821  
Louisville, Kentucky 40202-2230

(b) The copy of any protest shall be received in the office designated above on the same day a protest is filed with the GSBICA or within one day of filing a protest with the GAO.

39. COMMERCIAL AND GOVERNMENT ENTITY (CAGE) CODE REPORTING (DEC 1991)  
DFARS 252.204-7001

(a) The Offeror is requested to enter its CAGE code on its offer in the block with its name and address. The CAGE code entered must be for that name and address. Enter CAGE before the number.

(b) If the Offeror does not have a CAGE code, it may ask the Contracting Officer to request one from the Defense Logistics Services Center (DLSC). The Contracting Officer will--

(1) Ask the Contractor to complete section B of a DD Form 2051, Request for Assignment of a Commercial and Government Entity (CAGE) Code;

(2) Complete section A and forward the form to DLSC; and

(3) Notify the Contractor of its assigned CAGE code.

(c) Do not delay submission of the offer pending receipt of a CAGE code.

20 March 1997

40. DATA UNIVERSAL NUMBERING SYSTEM (DUNS) NUMBER (APR 1998) FAR  
52.204-6.

(a) The offeror shall enter, in the block with its name and address on the cover page of its offer, the annotation "DUNS" followed by the DUNS number that identifies the offeror's name and address exactly as stated in the offer. The DUNS number is a nine-digit number assigned by Dun and Bradstreet Information Services.

(b) If the offeror does not have a DUNS number, it should contact Dun and Bradstreet directly to obtain one. A DUNS number will be provided immediately by telephone at no charge to the offeror. For information on obtaining a DUNS number, the offeror, if located within the United States, should call Dun and Bradstreet at 1-800-333-0505. The offeror should be prepared to provide the following information:

- (1) Company name.
- (2) Company address.
- (3) Company telephone number.
- (4) Line of business.
- (5) Chief executive officer/key manager.
- (6) Date the company was started.
- (7) Number of people employed by the company.
- (8) Company affiliation.

(c) Offerors located outside the United States may obtain the location and phone number of the local Dun and Bradstreet Information Services

office from the Internet Home Page at <http://www.dnb.com/>. If an offeror is unable to locate a local service center, it may send an e-mail to Dun and Bradstreet at [globalinfo@mail.dnb.com](mailto:globalinfo@mail.dnb.com).

41. NOT USED.

20 March 1997

42. NOTICE OF PRIORITY RATING FOR NATIONAL DEFENSE USE (SEP 1990) FAR 52.211-14.

42.1 Any contract awarded as a result of this solicitation will be a [ ] DX rated order; [X] DO-C2 rated order certified for national defense use under the Defense Priorities and Allocations System (DFARS) 15 CFR 700, and the Contractor will be required to follow all of the requirements of this regulation.

43. PRICE BASIS. Prices must be firm. Bids will not be considered which provide for subsequent increase in price.

2 Aug 1997

44. CONTRACT AWARD--SEALED BIDDING--CONSTRUCTION (AUG 1996) FAR 52.214-19.

44.1 The Government will evaluate bids in response to this solicitation without discussions and will award a contract to the responsible bidder whose bid, conforming to the solicitation, will be most advantageous to the Government, considering only price, price-related factors specified elsewhere in the solicitation.

44.2 The Government may reject any or all bids, and waive informalities on minor irregularities in bids received.

44.3 The Government may accept any item or combination of items, unless doing so is precluded by a restrictive limitation in the solicitation or the bid.

44.4 The Government may reject a bid as nonresponsive if the prices bid are materially unbalanced between line items or subline items. A bid is materially unbalanced when it is based on prices significantly less than cost for some work and prices which are significantly overstated in relation to cost for other work, and if there is a reasonable doubt that the bid will result in the lowest overall cost to the Government even though it may be the low evaluated bid, or if it is so unbalanced as to be tantamount to allowing an advance payment.

45. RESTRICTIVE LIMITATION (Ref. Para. 44.3). Except for Additives and Options, the Government shall accept all items listed in SECTION 00010 of this solicitation.

46. AWARD TO SINGLE BIDDERS. Subject to the provisions contained herein, award shall be made to a single bidder.

47. ADDITIVE OR DEDUCTIVE ITEMS (DEC 1991) DFARS 252.236-7007.

(a) The low offeror and the items to be awarded shall be determined as follows--

(1) Prior to the opening of bids, the Government will determine the amount of funds available for the project.



(2) The low offeror shall be the Offeror that --

- (i) Is otherwise eligible for award; and
- (ii) Offers the lowest aggregate amount for the first or base bid item, plus or minus (in order stated in the list of priorities in the bid schedule) those additive or deductive items that provide the most features within the funds determined available.

(3) The Contracting Officer shall evaluate all bids on the basis of the same additive or deductive items.

- (i) If adding another item from the bid schedule list of priorities would make the award exceed the available funds for all offerors, the Contracting Officer will skip that item and go to the next item from the bid schedule of priorities; and

- (ii) Add that next item if an award may be made that includes that item and is within the available funds.

(b) The Contracting Officer will use the list of priorities in the bid schedule only to determine the low offeror. After determining the low offeror, an award may be made on any combination of items if--

- (1) It is in the best interest of the Government;

- (2) Funds are available at the time of award; and

- (3) The low offeror's price for the combination to be awarded is less than the price offered by any other responsive, responsible offeror.

(c) Example

The amount available is \$100,000. Offeror A's base bid and four additives (in the order stated in the list of priorities in the bid Schedule) are \$85,000, \$10,000, \$8,000, \$6,000, and \$4,000. Offer B's bid and four additives are \$80,000, \$16,000, \$9,000, \$7,000, and \$4,000. Offeror A is the low offeror. The aggregate amount of offeror A's bid for purposes of award would be the \$99,000, which includes a base bid plus the first and fourth additives. The second and third additives were skipped because each of them would cause the aggregate bid to exceed \$100,000. At this stage, the SDB preference shall be evaluated as discussed in 5.(a)(3)(iii) above.

48. and 49. NOT USED.

**LOCATION OF BID OPENING.** Bidders are provided the following information as a service by the government. The government cannot be held liable for street closures, traffic delays or other problems that may be encountered due to reliance upon the government's suggested routes to the Federal Building.

**Motorist coming from I-65 North:**

Immediately after crossing the Kennedy bridge, take exit I-64 West (St. Louis). Once in I-64, take the 9th street exit. Continue straight on 9th street for approximately seven blocks to Broadway (first major street with two-way traffic). Turn left on Broadway; go two blocks and turn left on 7th street (7th street is one-way north bound). Approximately ½ block north on 7th street is a stop light, our building is on the right just past the light. There should be ample parking available either by street-side or garage parking. Upon entering the building proceed to the eighth floor and go to room 821.

**Motorist coming from I-65 South:**

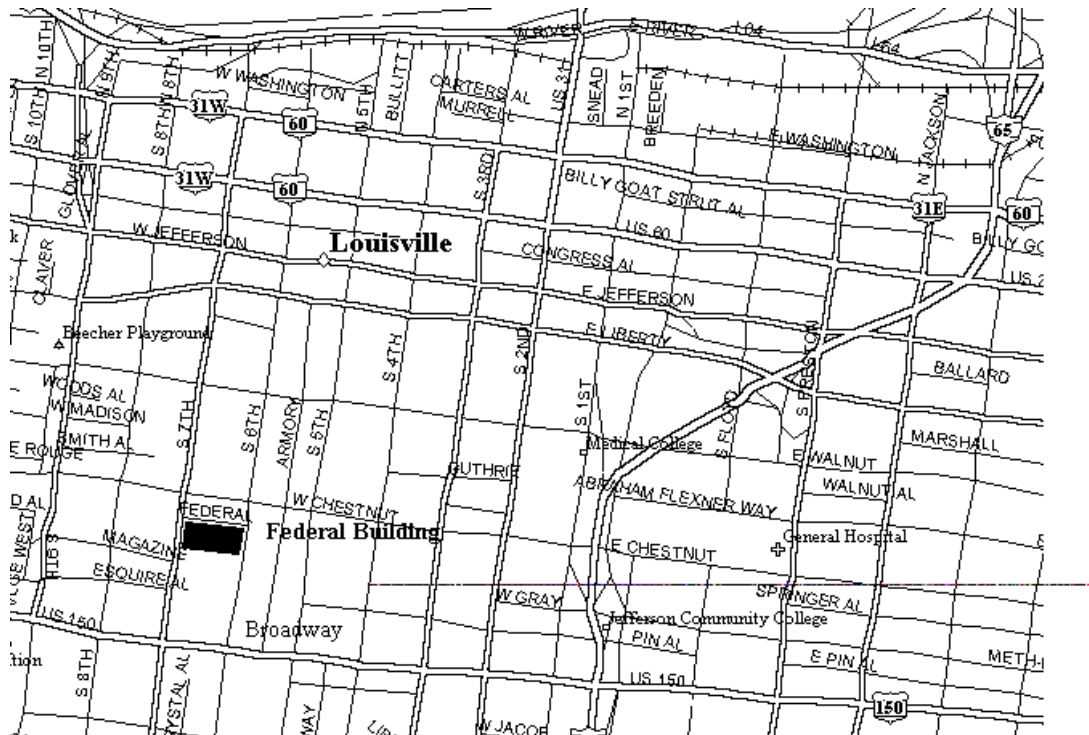
Take Broadway exit and turn left on Broadway (west bound) and continue to 7th street and turn right. Approximately ½ block north on 7th street is a stop light, our building is on the right just past the light. There should be ample parking available either by street-side or garage parking. Upon entering the building proceed to the eighth floor and go to room 821.

**Motorist coming from I-64 East and West:**

Exit the 9th street exit. At the bottom of the ramp continue south down 9th street for approximately seven blocks until you come to Broadway (first major two way street). Turn left on Broadway and to two blocks and turn left on 7th street (7th street is one-way north bound). Approximately ½ block north on 7th street is a stop light, our building is on the right just past the light. There should be ample parking available either by street-side or garage parking. Upon entering the building proceed to the eighth floor and go to room 821.

**Motorist coming from I-71:**

Follow routing for intersecting with I-64 and follow the instructions for I-64 motorists.



**<sup>1</sup>SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL  
BUSINESS SUBCONTRACTING PLAN**

DATE: \_\_\_\_\_

CONTRACTOR: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

SOLICITATION OR CONTRACT NUMBER: \_\_\_\_\_

ITEM/SERVICE: \_\_\_\_\_

The following, together with any attachments, is hereby submitted as a Subcontracting Plan to satisfy the applicable requirements of Public Law 95-507 as implemented by OFPP Policy Letter 80-2.

1. (a) The following goals (expressed in terms of a percentage and dollar values of total planned subcontracting dollars) are applicable to the contract or solicitation cited above.

See page 1a

(b) The following principal products and/or services will be subcontracted under this contract, and the distribution among small, small disadvantaged and women-owned small business concerns is as follows:

**(Designated products/services to be subcontracted to: small business concerns by "\*" small disadvantaged business concerns by "\*\*\*"; and women-owned small business concerns by "\*\*\*\*")**

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(ATTACHMENT MAY BE USED IF ADDITIONAL SPACE IS REQUIRED)

(c) The following method was used in developing subcontract goals (i.e., Statement explaining how the product and service areas to be subcontracted were established, how the areas to be subcontracted to small, small disadvantaged and women-owned small business concerns were determined, and how small, small disadvantaged and women-owned small business concerns'

capabilities were determined, to include identification of source lists utilized in making those determinations).

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(d) Indirect and overhead costs (check one): \_\_\_\_ have been \_\_\_\_ have not been included in the goals specified in 1(a) and 1(b).

(e) If "have been" is checked, explain the method used in determining the proportionate share of indirect and overhead cost to be allocated as subcontracts to small, small disadvantaged and women-owned small business concerns.

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2. The following individual will administer the subcontracting program:

Name & Title: \_\_\_\_\_

Address & Telephone: \_\_\_\_\_

This individual's specific duties, as they relate to the firm's subcontracting program, are as follows:

General overall responsibility for this company's Small Business Program, the development, preparation and execution of individual subcontracting plans and for monitoring performance relative to contractual subcontracting requirements contained in this plan, including but not limited to:

(a) Developing and maintaining offerors/bidders lists of small, small disadvantaged and women-owned small business concerns from all possible sources.

(b) Ensuring that procurement packages are structured to permit small, small disadvantaged and women-owned small business concerns to participate to the maximum extent possible.

(c) Assuring inclusion of small, small disadvantaged and women-owned small business concerns in all solicitations for products or services which they are capable of providing.

(d) Reviewing solicitations to remove statements, clauses, etc., which may tend to restrict or prohibit small, small disadvantaged and women-owned small business participation.

(e) Ensuring periodic rotation of potential subcontractors on bidders lists.

(f) Ensuring that the bid proposal review board documents its reasons for not selecting low bids submitted by small, small disadvantaged and women-owned small business concerns.

(g) Ensuring the establishment and maintenance of records of solicitations and subcontract award activity.

(h) Attending or arranging for attendance of company counselors at Business Opportunity Workshops, Minority Business Enterprise Seminars, Trade Fairs, etc.

(i) Conducting or arranging for conduct of motivational training for purchasing personnel pursuant to the intent of Public Law 95-507.

(j) Monitoring attainment of proposed goals.

(k) Preparing and submitting periodic subcontracting reports required, which will include Standard Form (SF) 294, Subcontracting Report for Individual Contracts, and SF 295, Summary Subcontract Report, in accordance with the instructions on the forms.

(l) Coordinating contractor's activities during the conduct of compliance reviews by Federal agencies.

(m) Coordinating the conduct of contractor's activities involving its small, small disadvantaged, and women-owned small business subcontracting program.

(n) Additions to (or deletions from) the duties specified above are as follows:

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3. The following efforts will be taken to assure that small, small disadvantaged and women-owned small business concerns will have an equitable opportunity to compete for subcontracts:

(a) Outreach efforts will be made by:

(i) Contacts with minority and small business trade associations.

(ii) Contacts with business development organizations.

(iii) Attendance at small and minority business procurement conferences and trade fairs.

(iv) Sources will be requested from Small Business Administration's appropriate Procurement Center Representative.

(b) The following internal efforts will be made to guide and encourage buyers:

(i) Workshops, seminars and training programs will be conducted.

(ii) Activities will be monitored to evaluate compliance with this subcontracting plan.

(c) Small, small disadvantaged and women-owned small business concern source lists, guides and other data identifying small, small disadvantaged and women-owned small business concerns will be maintained and utilized by buyers in soliciting subcontracts.

(d) Additions to (or deletion from) the above listed efforts are as follows:

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4. The offeror (contractor) agrees that the clause entitled "Utilization of Small, Small Disadvantaged and Women-Owned Small Business Concerns" will be included in all subcontracts which offer further subcontracting opportunities, and all subcontractors (except small business concerns) who receive subcontracts in excess of \$500,000 (\$1,000,000 in construction) will be required to adopt and comply with a subcontracting plan similar to this one. Such plans will be reviewed by comparing them with the provisions of Public Law 95-507, and assuring that all minimum requirements of an acceptable subcontracting plan have been satisfied. The acceptability of percentage goals shall be determined on a case-by-case basis depending on the supplies/services involved, the availability of potential small, small disadvantaged and women-owned small business subcontractors, and prior experience. Once approved and implemented, plans will be monitored through the submission of periodic reports, and/or, as time and availability of funds permit, periodic visits to subcontractors facilities to review applicable records and subcontracting program progress.

5. The offeror (contractor) agrees to submit such periodic reports and cooperate in any studies or surveys as may be required by the contracting agency or the Small Business Administration in order to determine the extent of compliance by the offeror with the subcontracting plan and with the clause entitled "Utilization of Small, Small Disadvantaged and Women-Owned Small Business

Concerns," contained in the contract. The above reports will include Standard Form (SF) 294, Subcontracting Report for Individual Contracts, and SF 295, Summary Subcontract Report, in accordance with the instructions on the forms.

6. The offeror (contractor) agrees that he will maintain at least the following types of records to document compliance with this subcontracting plan:

(a) Small, small disadvantaged and women-owned small business concern source lists, guides and other data identifying SB/SDB concerns.

(b) Organizations contacted for small, small disadvantaged and women-owned small business sources.

(c) On a contract-by-contract basis, records on all subcontract solicitations over \$100,000, indicating on each solicitation (i) whether small business concerns were solicited, and if not, why not; (ii) whether small disadvantaged business concerns were solicited, and if not, why not; (iii) whether women-owned small business concerns were solicited, and if not, why not; and (iv) reasons for the failure of solicited small, small disadvantaged or women-owned small business concerns to receive the subcontract award.

(d) Records to support other outreach efforts: Contracts with Minority and Small Business Trade Associations, etc., and attendance at small and minority business procurement conferences and trade fairs.

(e) Records to support internal activities to guide and encourage buyers: Workshops, seminars, training programs, etc., monitoring activities to evaluate compliance.

(f) On a contract-by-contract basis, records to support subcontract award data to include name and address and business size of each subcontractor.

(g) Records to be maintained in addition to the above are as follows:

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Signed:\_\_\_\_\_ Date:\_\_\_\_\_

Typed Name and Title:\_\_\_\_\_

Plan Accepted by:\_\_\_\_\_ Date:\_\_\_\_\_

Contracting Officer

NOTE TO CONTRACTING OFFICER: Upon incorporation of a plan into the contract indicated herein, the estimated dollar value of contract \$\_\_\_\_\_



CONTINUATION OF PARAGRAPH 1(a)

BASIC CONTRACT	Dollars	Percents
1. Total basic contract price	_____	
2. Total to be subcontracted (to all types of business concerns)	_____	_____
a. To large business	_____	_____
b. To small business	_____	_____
i. To nondisadvantaged small business	_____	_____
ii. To disadvantaged small business	_____	_____
iii. To women-owned small business	_____	_____

OPTIONS (if required)

NAME OF OPTION: \_\_\_\_\_

	Dollars	Percents
1. Total option price	_____	
2. Total to be subcontracted (to all types of business concerns)	_____	_____
a. To large business	_____	_____
b. To small business	_____	_____
i. To nondisadvantaged small business	_____	_____
ii. To disadvantaged small business	_____	_____
iii. To women-owned small business	_____	_____

(SUBMIT ADDITIONAL OPTION PAGES FOR EACH OPTION)

OPTIONS (if required)

NAME OF OPTION: \_\_\_\_\_

	Dollars	Percents
1. Total option price	_____	
2. Total to be subcontracted (to all types of business concerns)	_____	100%
a. To large business	_____	_____
b. To small business	_____	_____
i. To nondisadvantaged small business	_____	_____
ii. To disadvantaged small business	_____	_____
iii. To women-owned small business	_____	_____

NAME OF OPTION: \_\_\_\_\_

	Dollars	Percents
1. Total option price	_____	
2. Total to be subcontracted (to all types of business concerns)	_____	100%
a. To large business	_____	_____
b. To small business	_____	_____
i. To nondisadvantaged small business	_____	_____
ii. To disadvantaged small business	_____	_____
iii. To women-owned small business	_____	_____

## ARMY FEDERAL ACQUISITION REGULATION SUPPLEMENT

### APPENDIX CC -- SUBCONTRACTING PLAN EVALUATION GUIDE

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#### PART 2--SCORING SYSTEM

	<u>Range</u>	<u>Point Assigned</u>	<u>Points</u>
1. Policy statement or evidence of internal guidance to company buyers recognizing commitment to Pub.L. 99-661, Section 1207, and Pub.L. 100-180, Section 806.	0-5		

0 No written policy statement in plan.

1-2 Plan includes a general policy, but no evidence of recognition of special emphasis being placed on subcontracting with SDBs, HBCUs and MIs as a result of Pub.L.s.

3-5 Definitive corporate and management commitment evidenced in individual plan and master plan by specifically referencing the Pub.L.s.

	<u>Point Range</u>	<u>Points Assigned</u>
2. Efforts to broaden SB and SDB active vendor base. (FAR 19.704(a), 52.219-9(d), DFARS Subpart 219.5, 219.704(a)(1), 219.705 and 252.219-7003)	0-10	

0 Description of efforts merely parrots requirements of FAR to maintain listing of vendors.

1-2 Contains evidence that effort is directed at increasing subcontracts to SBs and SDBs for non-complex and general housekeeping supplies or services normally awarded to firms already in existing vendor base.

3-10 Addresses efforts to increase the number of SB and SDB sources awarded subcontracts, establishes plans to use competition restricted to SDBs and gives details about how plans to use competition restricted to SDBs will be accomplished. (DFARS 219.705-4 and Subpart 219.5)

NOTE: After scoring the plan to this point, if zero points have been assigned for Element 2, proceed to Item 3, Outreach. If one or more points have been assigned for this Element 2, proceed to evaluation of the subelements labeled "minus 2" and "minus 3" to determine if points assigned so far must be reduced. Do not reduce points already assigned to less than zero. (No negative points are to be entered under "Points Assigned" for any Element.) These negative scores are additive; if both of the subelements apply, then minus five points are assessed to reduce points already assigned under this element 2.

minus 2 Includes efforts described above which rate 1-2 or 3-10 points but, when it would be appropriate, does not address effort to involve HBCUs and MIs in performing the contract for which the subcontracting plan is submitted. (DFARS 219.704(a)(1) and 219.705-4(d))

## ARMY FEDERAL ACQUISITION REGULATION SUPPLEMENT

### APPENDIX CC -- SUBCONTRACTING PLAN EVALUATION GUIDE

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minus 3 Includes efforts described above which rate 1-2 or 3-10 points but does not address effort to identify and overcome obstacles which may prohibit award to HBCU and MI sources currently in vendor base.

	Point Range	Points Assigned
3. Outreach (ongoing and planned actions) (FAR 19.704(a), 19.705-4, 52.219-9(d) and 52.219-9(e), DFARS 219.705).	0-10	
0 No mention of outreach.		
1-4 Describes efforts to work with organizations in FAR 52.219-9(d)(11)(iv) to identify potential sources for items not traditionally awarded to SB or SDB firms. (FAR 52.219-9(d)(11)(iv) and 52.219-9(e))		
5-10 Indicates intent to conduct reviews to determine the competence, ability, experience and capacity available in SB or SDB firms and to provide technical assistance to SBs and SDBs or explains why such reviews or technical assistance are not appropriate. (FAR 19.705-4(c) and 52.219-9(e))		
NOTE: After scoring the plan to this point, if zero points have been assigned for Element 3, proceed to Item 4, Description of supplies and services. If one or more points have been assigned for this Element 3, proceed to evaluation of the subelement labeled "minus 3" to determine if points assigned so far must be reduced. Do not reduce points already assigned to less than zero. (No negative points are to be entered under "Points Assigned" for any Element.)		
minus 3 Fails to indicate the extent to which HBCU and MI participation will be considered and facilitated in performing the contract for which the subcontracting plan is submitted, or fails to indicate other efforts to increase HBCU and MI participation in future DoD acquisitions. (DFARS 219.705-4(d))		

	Point Range	Points Assigned
4. Describes supplies and services to be subcontracted and planned for subcontracting to SBs, SDBs, HBCUs and MIs. (FAR 19.705-4(d), 52.219-9(d)(3), 52.219-9(e) and DFARS 219.705).	0-10	
0 No mention.		
1-4 Generic list of routine supplies and services included in materials listing for the specific contract.		

## ARMY FEDERAL ACQUISITION REGULATION SUPPLEMENT

### APPENDIX CC -- SUBCONTRACTING PLAN EVALUATION GUIDE

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5-7 Indicates intent to review major product/system components and key project elements of R&D, construction, service and spare parts contracts for subcontracting to SBs, SDBs, HBCUs and MIs. (FAR 19.705-4(d)(3) and (4), 52.219-9(e)(1) and (2) and DFARS 219.705)

8-10 Substantive plan actually targets specific SBs, SDBs, HCBUs and MIs for review to determine their competence, ability, experience and capacity and identifies specific components or major portions of the acquisition for consideration of SB, SDB, HBCU or MI competition. Also, indicates intent to work with large business subcontractors for major subsystems or key project elements to ensure "flowdown" of this philosophy. (FAR 19.705-4(d) and DFARS 219.705)

	Point Range	Points Assigned
5. Describes specific efforts, based on results of efforts described in Elements No. 3 and No. 4 to ensure that SB, SDB, HBCU and MI concerns have equitable opportunity to participate in acquisitions. (FAR 19.704(a), 19.705-4, 52.219-9(d) and DFARS 219.705).	0-15	
0 No mention.		
1-4 Description of efforts merely parrots FAR 19.704(a)(3) and (6) and 52.219-9(d)(8).		
5-8 Describes how the company intends to evaluate its own SB and SDB award performance and program effectiveness against the established goals, both company-wide and for the individual plan being negotiated. (FAR 19.704(a)(1) and (6) and 52.219-9(d)(11)(v))		
9-12 Includes SBs, SDBs, HBCUs and MIs by name as members of original team for producing specific major components or subassemblies, providing a major service or performing a significant portion of the effort. (DFARS 219.705-2(d))		
13-15 Describes special efforts to establish long-range relationships with SBs, SDBs, HBCUs and MIs, including leader-follower techniques, when appropriate. (FAR 19.705-4(d)(4) and DFARS 219.705-2(d))		

	Point Range	Points Assigned
6. Development of percentage goal is based on planned subcontracting which is challenging, yet realistic. (FAR 19.705-4(d), DFARS 219.704(a)(1) and 219.705-4).	0-40	
0 Fails to include a specific goal for subcontracting with SBs, SDBs, HBCUs and MIs or proposes zero percent goal without substantive justification.		
1-5 Sets small business goal of less than 10 percent and/or SDB/HBCU/MI goal of two percent or less with no significant justification.		

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### APPENDIX CC -- SUBCONTRACTING PLAN EVALUATION GUIDE

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6-10 Sets goals of less than 10 percent (SB) and 2 percent (SDB), but contractor shows evidence of reasonable effort, including use of set-asides, to involve SBs, SDBs, HBCUs or MIs in non-traditional areas.

11-20 Sets goals of over 10 percent (SB) and 2 percent (SDB) and also identifies specific SB, SDB, HBCU or MI concerns planned to be subcontractors, including the item or service or effort to be subcontracted. Indicates extent to which firms have participated in proposal preparation or otherwise indicates extent to which subcontracting to these firms may reasonably be assured. Goals are realistic in view of actions stated in other portions of the plan and make-or-buy plan, if applicable.

21-30 Same as for 11-20 points, but proposed percent of goal is reasonable in comparison with prior experience, yet indicates reasonable effort to improve on past experience in terms of dollars, number of SDBs, HBCUs, and MIs involved, and movement into area without previous SDB, HBCU or MI involvement.

31-40 Same as 21-30 points, but includes evidence that if SBs, universities or institutions other than HBCUs or MIs are performing on a major component or subassembly, providing a major service or performing on a key project element, SDBs, HBCUs and MIs will also be given an opportunity to perform. Also, the percentage of the SDB, HBCU, MI goal compares favorably with the percentage of SB goal, consistent with the Government-wide goals of 20 percent to SB with five percent to SDB, or is otherwise explained, and the plan includes a forecast for improvement. (The SB and SDB goals in the subcontracting plan should approximate the ratio between the SB and SDB Government-wide goals.)

Point Range	Points Assigned
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#### 7. Past performance.

0-10

Extent to which the company has historically been successful in establishing realistic, yet challenging, goals and achieving them. Consider DCMC comments on prime contractor's justifications for prior failure to achieve goals. To avoid penalizing the contractor when there has been no previous defense contract, assign 10 points. (FAR 19.705-4(d)(1) and (d)(2)(iii), 19.706 and DFARS 219.706).

#### 8. Other regulatory and statutory requirements.

If any of the following are answered "NO," the plan is not acceptable and must be revised to comply prior to award:

Does the plan have--

A. A separate goal for SB and SDB? (FAR 19.704(a)(1) and FAR 52.219-9(d)(1) and (2))

YES \_\_\_\_ NO \_\_\_\_

ARMY FEDERAL ACQUISITION REGULATION SUPPLEMENT

APPENDIX CC -- SUBCONTRACTING PLAN EVALUATION GUIDE

- B. A separate goal for the basic contract and, if applicable, each option? (FAR 19.704(c))  
YES \_\_\_\_ NO \_\_\_\_
- C. The name of the company employee responsible for administration of plan and employee's duties? (FAR 19.704(a)(2) and 52.219-9(d)(7))  
YES \_\_\_\_ NO \_\_\_\_
- D. A statement affirming intent to comply with subcontracting "flowdown" provisions? (FAR 19.704(a)(4) and 52.219-9(d)(10))  
YES \_\_\_\_ NO \_\_\_\_
- E. A statement affirming willingness to cooperate in studies and to provide reports? (FAR 19.704(a)(5) and 52.219-9(d)(10))  
YES \_\_\_\_ NO \_\_\_\_
- F. A statement that indirect costs are either included or excluded from the proposed goals and, if included, how they will be prorated? (FAR 52.219-9(d)(6))  
YES \_\_\_\_ NO \_\_\_\_
- G. A description of efforts to ensure that SBs and SDBs have an equitable opportunity to participate in the acquisition? (FAR 52.219-9(d)(8))  
YES \_\_\_\_ NO \_\_\_\_
- H. A recitation of the types of records maintained to demonstrate procedures adopted to comply with the requirements and goal in the plan? (FAR 52.219-9(d)(11))  
YES \_\_\_\_ NO \_\_\_\_

**BIDDER: READ CAREFULLY - CHECK ALL APPLICABLE BOXES**

**SECTION 00605**

**REPRESENTATIONS, CERTIFICATIONS, AND OTHER STATEMENTS OF BIDDER  
FOR SEALED BID CONSTRUCTION CONTRACTS**

**DATE OF OFFER:** \_\_\_\_\_ **DUNS NO.** \_\_\_\_\_

**SOLICITATION NO.** \_\_\_\_\_ **CAGE NO.** \_\_\_\_\_

**NAME AND ADDRESS OF OFFEROR:** \_\_\_\_\_

The offeror makes the following representations and certifications as part of the offer referenced above.

**1. CERTIFICATE OF INDEPENDENT PRICE DETERMINATION (APR 1985) FAR 52.203-2**

(a) The offeror certifies that--

(1) The prices in this offer have been arrived at independently, without, for the purpose of restricting competition, any consultation, communication, or agreement with any other offeror or competitor relating to (i) those prices, (ii) the intention to submit an offer, or (iii) the methods or factors used to calculate the prices offered;

(2) The prices in this offer have not been and will not be knowingly disclosed by the offeror, directly or indirectly, to any other offeror or competitor before bid opening (in the case of a sealed bid solicitation) or contract award (in the case of a negotiated solicitation) unless otherwise required by law; and

(3) No attempt has been made or will be made by the offeror to induce any other concern to submit or not to submit an offer for the purpose of restricting competition.

(b) Each signature on the offer is considered to be a certification by the signatory that the signatory--

(1) Is the person in the offeror's organization responsible for determining the prices being offered in this bid or proposal, and that the signatory has not participated and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision; or

(2) (i) Has been authorized, in writing, to act as agent for the following principals in certifying that those principals have not participated, and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision \_\_\_\_\_ *[insert full name of person(s) in the offeror's organization responsible for determining the prices offered in this bid or proposal, and the title of his or her position in the offeror's organization];*

(ii) As an authorized agent, does certify that the principals name in subdivision (b)(2)(i) of this provision have not participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision; and



(iii) As an agent, has not personally participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision.

(c) If the offeror deletes or modifies subparagraph (a)(2) of this provision, the offeror must furnish with its offer a signed statement setting forth in detail the circumstances of the disclosure.

(End of provision)

## **2. CERTIFICATION AND DISCLOSURE REGARDING PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (APR 1991) FAR 52.203-11**

(a) The definitions and prohibitions contained in the clause, at FAR 52.203-12, Limitation on Payments to Influence Certain Federal Transactions, included in this solicitation, are hereby incorporated by reference in paragraph (b) of this certification.

(b) The offeror, by signing its offer, hereby certifies to the best of his or her knowledge and belief that on or after December 23, 1989--

(1) No Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into any cooperative agreement, and the extension, continuation, renewal, amendment or modification of any Federal contract, grant, loan or cooperative agreement;

(2) If any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with this solicitation, the offeror shall complete and submit, with its offer, OMB standard form LLL, Disclosure of Lobbying Activities, to the Contracting Officer; and

(3) He or she will include the language of this certification in all subcontract awards at any tier and require that all recipients of subcontract awards in excess of \$100,000 shall certify and disclose accordingly.

(c) Submission of this certification and disclosure is a prerequisite for making or entering into this contract imposed by section 1352, title 31, United States Code. Any person who makes an expenditure prohibited under this provision or who fails to file or amend the disclosure form to be filed or amended by this provision, shall be subject to a civil penalty of not less than \$10,000, and not more than \$100,000, for each such failure.

(End of Provision)

**3. TAXPAYER IDENTIFICATION (JUN 1997) FAR 52.204-3****(a) Definitions.**

"Common parent," as used in this solicitation provision, means that corporate entity that owns or controls an affiliated group of corporations that files its Federal income tax returns on a consolidated basis, and of which the offeror is a member.

"Corporate status," as used in this solicitation provision, means a designation as to whether the offeror is a corporate entity, an unincorporated entity (e.g., sole proprietorship or partnership), or a corporation providing medical and health care services.

"Taxpayer Identification Number (TIN)," as used in this solicitation provision, means the number required by the IRS to be used by the offeror in reporting income tax and other returns.

(b) All offerors are required to submit the information required in paragraphs (c) through (e) of this solicitation provision in order to comply with reporting requirements of 26 U.S.C. 6041, 6041A, and 6050M and implementing regulations issued by the Internal Revenue Service (IRS). If the resulting contract is subject to the reporting requirements described in FAR 4.903, the failure or refusal by the offeror to furnish the information may result in a 31 percent reduction of payments otherwise due under the contract.

**(c) Taxpayer Identification Number (TIN).**

- ☐ TIN: \_\_\_\_\_
- ☐ TIN has been applied for.
- ☐ TIN is not required because:
  - ☐ Offeror is a nonresident alien, foreign corporation, or foreign partnership that does not have income effectively connected with the conduct of a trade or business in the U.S. and does not have an office or place of business or a fiscal paying agent in the U.S.;
  - ☐ Offeror is an agency or instrumentality of a foreign government;
  - ☐ Offeror is an agency or instrumentality of a Federal, state, or local government;
  - ☐ Other. State basis.

**(d) Corporate Status.**

- ☐ Corporation providing medical and health care services, or engaged in the billing and collecting of payments for such services;
- ☐ Other corporate entity;
- ☐ Not a corporate entity:
  - ☐ Sole proprietorship
  - ☐ Partnership
  - ☐ Hospital or extended care facility described in 26 CFR 501(c)(3) that is exempt from taxation under 26 CFR 501(a).

**(e) Common Parent.**

☐ Offeror is not owned or controlled by a common parent as defined in paragraph (a) of this provision.

☐ Name and TIN of Common parent:

Name \_\_\_\_\_ TIN \_\_\_\_\_  
(End of provision)

**4. WOMEN-OWNED BUSINESS (OCT 1995) FAR 52.204-5**

(a) **Representation.** The offeror represents that it ☐ is, ☐ is not a women-owned business concern.

(b) **Definition.** "Women-owned business concern," as used in this provision, means a concern which is at least 51 percent owned by one or more women; or in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and whose management and daily business operations are controlled by one or more women.

(End of provision)

**5. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, PROPOSED DEBARMENT, AND OTHER RESPONSIBILITY MATTERS (MAR 1996) FAR 52.209-5**

(a) (1) The Offeror certifies, to the best of its knowledge and belief, that--

(i) The Offeror and/or any of its Principals--

(A) Are ☐ are not ☐ presently debarred, suspended, proposed for debarment, or declared ineligible for the award of contracts by any Federal agency;

(B) Have ☐ have not ☐, within a three-year period preceding this offer, been convicted of or had a civil judgment rendered against them for: commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, state, or local) contract or subcontract; violation of Federal or state antitrust statutes relating to the submission of offers; or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, tax evasion, or receiving stolen property; and

(C) Are ☐ are not ☐ presently indicted for, or otherwise criminally or civilly charged by a governmental entity with, commission of any of the offenses enumerated in subdivision (a)(1)(i)(B) of this provision.

(ii) The Offeror has ☐ has not ☐, within a three-year period preceding this offer, had one or more contracts terminated for default by any Federal agency.

(2) "Principals," for the purposes of this certification, means officers; directors; owners; partners; and, persons having primary management or supervisory responsibilities within a business entity (e.g., general manager; plant manager; head of a subsidiary, division, or business segment, and similar positions).

THIS CERTIFICATION CONCERNS A MATTER WITHIN THE JURISDICTION OF AN AGENCY OF THE UNITED STATES AND THE MAKING OF A FALSE, FICTITIOUS, OR FRAUDULENT CERTIFICATION MAY RENDER THE MAKER SUBJECT TO PROSECUTION UNDER SECTION 1001, TITLE 18, UNITED STATES CODE.

(b) The Offeror shall provide immediate written notice to the Contracting Officer if, at any time prior to contract award, the Offeror learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

(c) A certification that any of the items in paragraph (a) of this provision exists will not necessarily result in withholding of an award under this solicitation. However, the certification will be considered in connection with a determination of the Offeror's responsibility. Failure of the Offeror to furnish a certification or provide such additional information as requested by the Contracting Officer may render the Offeror nonresponsible.

(d) Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by paragraph (a) of this provision. The knowledge and information of an Offeror is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

(e) The certification in paragraph (a) of this provision is a material representation of fact upon which reliance was placed when making award. If it is later determined that the Offeror knowingly rendered an erroneous certification, in addition to other remedies available to the Government, the Contracting Officer may terminate the contract resulting from this solicitation for default.

(End of provision)

## **6. DISCLOSURE OF OWNERSHIP OR CONTROL BY THE GOVERNMENT OF A TERRORIST COUNTRY (SEP 1994) DFARS 252.209-7001**

### **(a) Definitions.**

As used in this provision--

(1) "Government of a terrorist country" includes the state and the government of a terrorist country, as well as any political subdivision, agency, or instrumentality thereof.

(2) "Terrorist country" means a country determined by the Secretary of State, under section 6(j)(1)(A) of the Export Administration Act of 1979 (50 U.S.C. App. 2405 (j)(i)(A)), to be a country the government of which has repeatedly provided support for acts of international terrorism. As of the date of this provision, terrorist countries include: Cuba, Iran, Iraq, Libya, North Korea, Sudan, and Syria.

(3) "Significant interest" means--

(i) Ownership of or beneficial interest in 5 percent or more of the firm's or subsidiary's securities. Beneficial interest includes holding 5 percent or more of any class of the firm's securities in "nominee shares," "street names," or some other method of holding securities that does not disclose the beneficial owner;

(ii) Holding a management position in the firm, such as a director or officer;

(iii) Ability to control or influence the election, appointment, or tenure of directors or officers in the firm;

(iv) Ownership of 10 percent or more of the assets of a firm such as equipment, buildings, real estate, or other tangible assets of the firm; or

(v) Holding 50 percent or more of the indebtedness of a firm.

(b) **Prohibition on award.** In accordance with 10 U.S.C. 2327, no contract may be awarded to a firm or a subsidiary of a firm if the government of a terrorist country has a significant interest in the firm or subsidiary, unless a waiver is granted by the Secretary of Defense.

(c) **Disclosure.** If the government of a terrorist country has a significant interest in the Offeror or a subsidiary of the Offeror, the Offeror shall disclose such interest in an attachment to its offer. If the Offeror is a subsidiary, it shall also disclose any significant interest the government of a terrorist country has in any firm that owns or controls the subsidiary. The disclosure shall include--

(1) Identification of each government holding a significant interest; and

(2) A description of the significant interest held by each government.

(End of provision)

## 7. TYPE OF BUSINESS ORGANIZATION - SEALED BIDDING (JUL 1987) FAR 52.214-2

The bidder, by checking the applicable box, represents that--

(a) It operates as ☐ a corporation incorporated under the laws of the State of \_\_\_\_\_,  
☐ an individual ☐ a partnership, ☐ a nonprofit organization, or ☐ a joint venture; or

(b) If the bidder is a foreign entity, it operates as ☐ an individual, ☐ a partnership, ☐ a nonprofit organization, ☐ a joint venture, or ☐ a corporation, registered for business in

\_\_\_\_\_  
 (country)

(End of provision)

## 8. SMALL BUSINESS PROGRAM REPRESENTATIONS (APR 1998) FAR 52.219-1

(a) (1) The standard industrial classification (SIC) code for this acquisition is 1541.

(2) The small business size standard is \$17.0 million.

(3) The small business size standard for a concern which submits an offer in its own name, other than on a construction or service contract, but which proposes to furnish a product which it did not itself manufacture, is 500 employees.

(b) **Representations.** (1) The offeror represents as part of its offer that it ☐ is, ☐ is not a small business concern.

(2) (Complete only if offeror represented itself as a small business concern in paragraph (b)(1) of this provision.) The offeror represents as part of its offer that it [ ] is, [ ] is not a small disadvantaged business concern.

(3) (Complete only if offeror represented itself as a small business concern in paragraph (b)(1) of this provision.) The offeror represents as part of its offer that it [ ] is [ ] is not a women-owned small business concern.

(c) **Definitions.** "Joint venture," for purposes of a small disadvantaged business (SDB) set-aside or price evaluation preference (as prescribed at 13 CFR 124.321), is a concern that is owned and controlled by one or more socially and economically disadvantaged individuals entering into a joint venture agreement with one or more business concerns and is considered to be affiliated for size purposes with such other concern(s). The combined annual receipts or employees of the concerns entering into the joint venture must meet the applicable size standard corresponding to the SIC code designated for the contract. The majority of the venture's earnings must accrue directly to the socially and economically disadvantaged individuals in the SDB concerns(s) in the joint venture. The percentage of the ownership involvement in a joint venture by disadvantaged individuals must be at least 51 percent.

"Small business concern," as used in this provision, means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the criteria in 13 CFR Part 121 and the size standard in paragraph (a) of this provision.

"Small disadvantaged business concern," as used in this provision, means a small business concern that (1) is at least 51 percent unconditionally owned by one or more individuals who are both socially and economically disadvantaged, or a publicly owned business having at least 51 percent of its stock unconditionally owned by one or more socially and economically disadvantaged individuals, and (2) has its management and daily business controlled by one or more such individuals. This term also means a small business concern that is at least 51 percent unconditionally owned by an economically disadvantaged Indian tribe or Native Hawaiian Organization, or a publicly owned business having at least 51 percent of its stock unconditionally owned by one or more of these entities, which has its management and daily business controlled by members of an economically disadvantaged Indian tribe or Native Hawaiian Organization, and which meets the requirements of 13 CFR Part 124.

"Woman-owned small business concern," as used in this provision, means a small business concern--

(1) Which is at least 51 percent owned by one or more women or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and

(2) Whose management and daily business operations are controlled by one or more women.

(d) **Notice.** (1) If this solicitation is for supplies and has been set aside, in whole or in part, for small business concerns, then the clause in this solicitation providing notice of the set-aside contains restrictions on the source of the end items to be furnished.

(2) Under 15 U.S.C. 645(d), any person who misrepresents a firm's status as a small or small disadvantaged business concern in order to obtain a contract to be awarded under the preference programs

established pursuant to sections 8(a), 8(d), 9, or 15 of the Small Business Act or any other provision of Federal law that specifically references section 8(d) for a definition of program eligibility, shall--

- (i) Be punished by imposition of fine, imprisonment, or both;
  - (ii) Be subject to administrative remedies, including suspension and debarment; and
  - (iii) Be ineligible for participation in programs conducted under the authority of the Act.
- (End of provision)

## 9. EQUAL LOW BIDS (OCT 1995) FAR 52.219-2

- (a) This provision applies to small business concerns only.

(b) The bidder's status as a labor surplus area (LSA) concern may affect entitlement to award in case of tie bids. If the bidder wishes to be considered for this priority, the bidder must identify, in the following space, the LSA in which the costs to be incurred on account of manufacturing or production (by the bidder or the first-tier subcontractors) amount to more than 50 percent of the contract price.

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(c) Failure to identify the labor surplus areas as specified in paragraph (b) of this provision will preclude the bidder from receiving priority consideration. If the bidder is awarded a contract as a result of receiving priority consideration under this provision and would not have otherwise received award, the bidder shall perform the contract or cause the contract to be performed in accordance with the obligations of an LSA concern.

(End of provision)

## 10. SMALL BUSINESS CONCERN REPRESENTATION FOR THE SMALL BUSINESS COMPETITIVENESS DEMONSTRATION PROGRAM (JAN 1997) FAR 52.219-19

(a) **Definition.** "Emerging small business" as used in this solicitation, means a small business concern whose size is no greater than 50 percent of the numerical size standard applicable to the standard industrial classification code assigned to a contracting opportunity.

(b) **(Complete only if the Offeror has represented itself under the provision at 52.219-1 as a small business concern under the size standards of this solicitation.)** The Offeror [ ] is, [ ] is not an emerging small business.

(c) **(Complete only if the Offeror is a small business or an emerging small business, indicating its size range.)** Offeror's number of employees for the past 12 months (check this column if size standard stated in solicitation is expressed in terms of number of employees) or Offeror's average annual gross revenue for the last 3 fiscal years (check this column if size standard stated in solicitation is expressed in terms of annual receipts - see paragraph 11(a) (2) Small Business Program Representations).

(Construction Solicitations)

## Number of Employees

## Avg. Annual Gross Revenues

☐ 50 or fewer  
☐ 51 - 100  
☐ 101 -250  
☐ 251 - 500  
☐ 501 - 750  
☐ 751 - 1,000  
☐ Over 1,000

☐ \$1 million or less  
☐ \$1,000,001 - \$2 million  
☐ \$2,000,001 - \$3.5 million  
☐ \$3,500,001 - \$5 million  
☐ \$5,000,001 - \$10 million  
☐ \$10,000,001 - \$17 million  
☐ Over \$17 million

(End of provision)

# 11. SMALL DISADVANTAGED BUSINESS CONCERN REPRESENTATION (DoD CONTRACTS) (JUN 1997) DFARS 252.219-7000

(a) **Definition.** "Small disadvantaged business concern," as used in this provision, means a small business concern, owned and controlled by individuals who are both socially and economically disadvantaged, as defined by the Small Business Administration at 13 CFR Part 124, the majority of earnings of which directly accrue to such individuals. This term also means a small business concern owned and controlled by an economically disadvantaged Indian tribe or Native Hawaiian organization which meets the requirements of 13 CFR 124.112 or 13 CFR 124.113, respectively. In general, 13 CFR Part 124 describes a small disadvantaged business concern as a small business concern--

(1) Which is at least 51 percent unconditionally owned by one or more socially and economically disadvantaged individuals; or

(2) In the case of any publicly owned business, at least 51 percent of the voting stock is unconditionally owned by one or more socially and economically disadvantaged individuals; and

(3) Whose management and daily business operations are controlled by one or more such individuals.

(b) **Representations.** Check the category in which your ownership falls--

☐ Subcontinent Asian (Asian-Indian) American (U.S. citizen with origins from India, Pakistan, Bangladesh, Sri Lanka, Bhutan, the Maldives Islands, or Nepal)

☐ Asian-Pacific American (U.S. citizen with origins from Japan, China, the Philippines, Vietnam, Korea, Samoa, Guam, U.S. Trust Territory of the Pacific Islands (Republic of Palau), the Northern Mariana Islands, Laos, Kampuchea (Cambodia), Taiwan, Burma, Thailand, Malaysia, Indonesia, Singapore, Brunei, Republic of the Marshall Islands, the Federated States of Micronesia, Macao, Hong Kong, Fiji, Tonga, Kiribati, Tuvalu, or Nauru)

☐ Black American (U.S. citizen)

☐ Hispanic American (U.S. citizen with origins from South American, Central America, Mexico, Cuba, the Dominican Republic, Puerto Rico, Spain, or Portugal)

☐ Native American (American Indians, Eskimos, Aleuts, or Native Hawaiians, including



Indian tribes or Native Hawaiian organizations)

\_\_\_\_\_ Individual/concern, other than one of the preceding, currently certified for participation In the Minority Small Business and Capital Ownership Development Program under Section 8(a) of the Small Business Act.

\_\_\_\_\_ Other

(c) Complete the following--

(1) The offeror is [ ], is not [ ] a small disadvantaged business concern.

(2) The Small Business Administration (SBA) has [ ] has not [ ] made a determination concerning the offeror's status as a small disadvantaged business concern. If the SBA has made a determination, the date of the determination was \_\_\_\_\_ and the offeror--

\_\_\_\_\_ Was found by SBA to be socially and economically disadvantaged and no circumstances have changed to vary that determination.

\_\_\_\_\_ Was found by SBA not to be socially and economically disadvantaged but circumstances which caused the determination have changed.

(d) **Penalties and Remedies.** Anyone who misrepresents the status of a concern as a small disadvantaged business for the purpose of securing a contract or subcontract shall--

(1) Be punished by imposition of a fine, imprisonment, or both;

(2) Be subject to administrative remedies, including suspension and debarment; and

(3) Be ineligible for participation in programs conducted under authority of the Small Business Act.

(End of Provision)

## 12. CERTIFICATION OF NONSEGREGATED FACILITIES (APR 1984) FAR 52.222-21

(a) "Segregated facilities," as used in this provision, means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees, that are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, or national origin because of habit, local custom, or otherwise.

(b) By the submission of this offer, the offeror certifies that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The offeror agrees that a breach of this certification is a violation of the Equal Opportunity clause in the contract.

(c) The offeror further agrees that (except where it has obtained identical certifications from proposed subcontractors for specific time periods) it will--

(1) Obtain identical certifications from proposed subcontractors before the award of subcontracts under which the subcontractor will be subject to the Equal Opportunity clause;

(2) Retain the certifications in the files; and

(3) Forward the following notice to the proposed subcontractors (except if the proposed subcontractors have submitted identical certifications for specific time periods):

**NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENT  
FOR CERTIFICATIONS OF NONSEGREGATED FACILITIES**

A Certification of Nonsegregated Facilities must be submitted before the award of a subcontract under which the subcontractor will be subject to the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually).

NOTE: The penalty for making false statements in offers is prescribed in 18. U.S.C. 1001.

(End of Provision)

**13. PREVIOUS CONTRACTS AND COMPLIANCE REPORTS (APR 1984) FAR 52.222-22**

The offeror represents that--

(a) It [ ] has [ ] has not, participated in a previous contract or subcontract subject either to the Equal Opportunity clause of this solicitation, the clause originally contained in Section 310 of Executive Order No. 10925, or the clause contained in Section 201 of Executive Order No. 11114;

(b) It [ ] has, [ ] has not, filed all required compliance reports; and

(c) Representations indicating submission of required compliance reports, signed by proposed subcontractors, will be obtained before subcontract awards.

(End of Provision)

**14. CLEAN AIR AND WATER CERTIFICATION (APR 1984) FAR 52.223-1**

The Offeror certifies that--

(a) Any facility to be used in the performance of this proposed contract [ ] is, [ ] is not listed on the Environmental Protection Agency (EPA) List of Violating Facilities;

(b) The Offeror will immediately notify the Contracting Officer, before award, of the receipt of any communication from the Administrator, or a designee, of the EPA, indicating that any facility that the Offeror proposes to use for the performance of the contract is under consideration to be listed on the EPA List of Violating Facilities; and

(c) The Offeror will include a certification substantially the same as this certification, including this paragraph (c), in every nonexempt subcontract.

(End of Provision)

**15. CERTIFICATION OF TOXIC CHEMICAL RELEASE REPORTING (OCT 1996)**

**FAR 52.223-13**

(a) Submission of this certification is a prerequisite for making or entering into this contract imposed by Executive Order 12969, August 8, 1995.

(b) By signing this offer, the offeror certifies that--

(1) As the owner or operator of facilities that will be used in the performance of this contract that are subject to the filing and reporting requirements described in section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) (42 U.S.C. 11023) and section 6607 of the Pollution Prevention Act of 1990 (PPA) (42 U.S.C. 13106), the offeror will file and continue to file for such facilities for the life of the contract the Toxic Chemical Release Inventory Form (Form R) as described in sections 313(a) and (g) of EPCRA and section 6607 of PPA; or

(2) None of its owned or operated facilities to be used in the performance of this contract is subject to the Form R filing and reporting requirements because each such facilities is exempt for at least one of the following reasons: *(Check each block that is applicable.)*

- ☐ (i) The facility does not manufacture, process or otherwise use any toxic chemicals listed under section 313(c) of EPCRA, 42 U.S.C. 11023(c);
- ☐ (ii) The facility does not have 10 or more full-time employees as specified in section 313(b)(1)(A) of EPCRA, 42 U.S.C. 11023(b)(1)(A);
- ☐ (iii) The facility does not meet the reporting thresholds of toxic chemicals established under section 313(f) of EPCRA, 42 U.S.C. 11023(f) (including the alternate thresholds at 40 CFR 372.27, provided an appropriate certification form has been filed with EPA);
- ☐ (iv) The facility does not fall within the Standard Industrial Classification Code (SIC) designations 20 through 39 as set forth in section 19.102 of the Federal Acquisition Regulation; or

☐ (v) The facility is not located within any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Northern Mariana Islands, or any other territory or possession over which the United States has jurisdiction.

(End of provision)

(End of Section 00605)

**SECTION 00700**  
**INDEX OF CONTRACT CLAUSES (CONSTRUCTION)**  
**Issued by: Department of the Army, Corps of Engineers**  
**Louisville District**

**Edition of 1 JUNE 1998**

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**1. CONTRACTING OFFICER'S REPRESENTATIVE (DEC 1991) DFARS 252.201-7000**

(a) *Definition.* "Contracting officer's representative" means an individual designated in accordance with subsection 201.602-2 of the Defense Federal Acquisition Regulation Supplement and authorized in writing by the Contracting Officer to perform specific technical or administrative functions.

(b) If the Contracting Officer designates a Contracting Officer's Representative (COR), the Contractor will receive a copy of the written designation. It will specify the extent of the COR's authority to act on behalf of the Contracting Officer. The COR is not authorized to make any commitments or changes that will affect price, quality, quantity, delivery, or any other term or condition of the contract.

(End of clause)

**2. DEFINITIONS (OCT 1995)--ALTERNATE I (APR 1984) FAR 52.202-1 I**

(a) "Head of the agency" (also called "agency head") or "Secretary" means the Secretary (or Attorney General, Administrator, Governor, Chairperson, or other chief official, as appropriate) of the agency, including any deputy or assistant chief official of the agency; and the term "authorized representative" means any person, persons, or board (other than the Contracting Officer) authorized to act for the head of the agency or Secretary.

(b) "Commercial component" means any component that is a commercial item.

(c) "Component" means any item supplied to the Federal Government as part of an end item or of another component.

(d) "Nondevelopmental item" means--

(1) Any previously developed item of supply used exclusively for governmental purposes by a Federal agency, a State or local government, or a foreign government with which the United States has a mutual defense cooperation agreement;

(2) Any item described in paragraph (d)(1) of this definition that requires only minor modification or modifications of a type customarily available in the commercial marketplace in order to meet the requirements of the procuring department or agency; or

(3) Any item of supply being produced that does not meet the requirements of paragraph (d)(1) or (d)(2) solely because the item is not yet in use.

(e) "Contracting Officer" means a person with the authority to enter into, administer, and/or terminate contracts and make related determinations and findings. The term includes certain authorized representatives of the Contracting Officer acting within the limits of their authority as delegated by the Contracting Officer.

(f) Except as otherwise provided in this contract, the term "subcontracts" includes, but is not limited to, purchase orders and changes and modifications to purchase orders under this contract.

(End of clause)

**3. GRATUITIES (APR 1984) FAR 52.203-3**

(a) The right of the Contractor to proceed may be terminated by written notice if, after notice and hearing, the agency head or a designee determines that the Contractor, its agent, or another representative--

(1) Offered or gave a gratuity (e.g., an entertainment or gift) to an officer, official, or employee of the Government; and

(2) Intended, by the gratuity, to obtain a contract or favorable treatment under a contract.

(b) The facts supporting this determination may be reviewed by any court having lawful jurisdiction.

(c) If this contract is terminated under paragraph (a) of this clause, the Government is entitled--

(1) To pursue the same remedies as in a breach of the contract; and

(2) In addition to any other damages provided by law, to exemplary damages of not less than 3 nor more than 10 times the cost incurred by the Contractor in giving gratuities to the person concerned, as determined by the agency head or a designee. (This subparagraph (c)(2) is applicable only if this contract uses money appropriated to the Department of Defense.)

(d) The rights and remedies of the Government provided in this clause shall not be exclusive and are in addition to any other rights and remedies provided by law or under this contract.

(End of clause)

**4. COVENANT AGAINST CONTINGENT FEES (APR 1984) FAR 52.203-5**

(a) The Contractor warrants that no person or agency has been employed or retained to solicit or obtain this contract upon an agreement or understanding for a contingent fee, except a bona fide employee or agency. For breach or violation of this warranty, the Government shall have the right to annul this contract without liability or, in its discretion, to deduct from the contract price or consideration, or otherwise recover, the full amount of the contingent fee.

(b) "Bona fide agency," as used in this clause, means an established commercial or selling agency, maintained by a contractor for the purpose of securing business, that neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds itself out as being able to obtain any Government contract or contracts through improper influence.

"Bona fide employee," as used in this clause, means a person, employed by a contractor and subject to the contractor's supervision and control as to time, place, and manner of performance, who neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds out as being able to obtain any Government contract or contracts through improper influence.

"Contingent fee," as used in this clause, means any commission, percentage, brokerage, or other fee that is contingent upon the success that a person or concern has in securing a Government contract.

"Improper influence," as used in this clause, means any influence that induces or tends to induce a Government employee or officer to give consideration or to act regarding a Government contract or any basis other than the merits of the matter.

(End of clause)

## **5. ANTI-KICKBACK PROCEDURES (JUL 1995) FAR 52.203-7**

### *(a) Definitions.*

"Kickback," as used in this clause, means any money, fee, commission, credit, gift, gratuity, thing of value, or compensation of any kind which is provided, directly or indirectly, to any prime Contractor, prime Contractor employee, subcontractor, or subcontractor employee for the purpose of improperly obtaining or rewarding favorable treatment in connection with a prime contract or in connection with a subcontract relating to a prime contract.

"Person," as used in this clause, means a corporation, partnership, business association of any kind, trust, joint-stock company, or individual.

"Prime contract," as used in this clause, means a contract or contractual action entered into by the United States for the purpose of obtaining supplies, materials, equipment or services of any kind.

"Prime Contractor" as used in this clause, means a person who has entered into a prime contract with the United States.

"Prime Contractor employee," as used in this clause, means any officer, partner, employee, or agent of a prime Contractor.

"Subcontract," as used in this clause, means a contract or contractual action entered into by a prime Contractor or subcontractor for the purpose of obtaining supplies, materials, equipment, or services of any kind under a prime contract.

"Subcontractor," as used in this clause, (1) means any person, other than the prime Contractor, who offers to furnish or furnishes any supplies, materials, equipment, or services of any kind under a prime contract or a subcontract entered into in connection with such prime contract, and (2) includes any person who offers to furnish or furnishes general supplies to the prime Contractor or a higher tier subcontractor.

"Subcontractor employee," as used in this clause, means any officer, partner, employee, or agent of a subcontractor.

(b) The Anti-Kickback Act of 1986 (41 U.S.C. 51-58) (the Act), prohibits any person from--

- (1) Providing or attempting to provide or offering to provide any kickback;
- (2) Soliciting, accepting, or attempting to accept any kickback; or
- (3) Including, directly or indirectly, the amount of any kickback in the contract price charged by a prime Contractor to the United States or in the contract price charged by a subcontractor to a prime Contractor or higher tier subcontractor.

(c)(1) The Contractor shall have in place and follow reasonable procedures designed to prevent and detect possible violations described in paragraph (b) of this clause in its own operations and direct business relationships.

(2) When the Contractor has reasonable grounds to believe that a violation described in paragraph (b) of this clause may have occurred, the Contractor shall promptly report in writing the possible violation. Such reports shall be made to the inspector general of the contracting agency, the head of the contracting agency if the agency does not have an inspector general, or the Department of Justice.

(3) The Contractor shall cooperate fully with any Federal agency investigating a possible violation described in paragraph (b) of this clause.

(4) The Contracting Officer may (i) offset the amount of the kickback against any monies owed by the United States under the prime contract and/or (ii) direct that the Prime Contractor withhold from sums owed a subcontractor under the prime contract the amount of the kickback. The Contracting Officer may order that monies withheld under subdivision (c)(4)(ii) of this clause be paid to the Government unless the Government has already offset those monies under subdivision (c)(4)(i) of this clause. In either case, the Prime Contractor shall notify the Contracting Officer when the monies are withheld.

(5) The Contractor agrees to incorporate the substance of this clause, including subparagraph (c)(5) but excepting subparagraph (c)(1), in all subcontracts under this contract which exceed \$100,000.

(End of clause)

## **6. CANCELLATION, RESCISSION, AND RECOVERY OF FUNDS FOR ILLEGAL OR IMPROPER ACTIVITY (JAN 1997) FAR 52.203-8**

(a) If the Government receives information that a contractor or a person has engaged in conduct constituting a violation of subsection (a), (b), (c), or (d) of Section 27 of the Office of Federal Procurement Policy Act (41 U.S.C. 423) (the Act), as amended by section 4304 of the 1996 National Defense Authorization Act for Fiscal Year 1996 (Pub.L. 104-106), the Government may--

(1) Cancel the solicitation, if the contract has not yet been awarded or issued; or

(2) Rescind the contract with respect to which--

(i) The Contractor or someone acting for the Contractor has been convicted for an offense where the conduct constitutes a violation of subsection 27 (a) or (b) of the Act for the purpose of either--

(A) Exchanging the information covered by such subsections for anything of value; or

(B) Obtaining or giving anyone a competitive advantage in the award of a Federal agency procurement contract; or

(ii) The head of the contracting activity has determined, based upon a preponderance of the evidence, that the Contractor or someone acting for the Contractor has engaged in conduct constituting an offense punishable under subsections 27(e) (1) of the Act.

(b) If the Government rescinds the contract under paragraph (a) of this clause, the Government is entitled to recover, in addition to any penalty prescribed by law, the amount expended under the contract.

(c) The rights and remedies of the Government specified herein are not exclusive, and are in addition to any other rights and remedies provided by law, regulation, or under this contract.

(End of clause)

## **7. PRICE OR FEE ADJUSTMENT FOR ILLEGAL OR IMPROPER ACTIVITY (JAN 1997) FAR 52.203-10**

(a) The Government, at its election, may reduce the price of a fixed-price type contract and the total cost and fee under a cost-type contract by the amount of profit or fee determined as set forth in paragraph (b) of this clause if the head of the contracting activity or designee determines that there was a violation of subsection 27(a), (b), or (c) of the Office of Federal Procurement Policy Act, as amended (41 U.S.C. 423), as implemented in section 3.104 of the Federal Acquisition Regulation. In the case of a contract modification, the fee subject to reduction is the fee specified in the particular contract modification at the time of execution, except as provided in subparagraph (b)(5) of this clause.

(b) The price or fee reduction referred to in paragraph (a) of this clause shall be--

(1) For cost-plus-fixed-fee contracts, the amount of the fee specified in the contract at the time of award;

(2) For cost-plus-incentive-fee contracts, the target fee specified in the contract at the time of award, notwithstanding any minimum fee or "fee floor" specified in the contract;

(3) For cost-plus-award-fee contracts--

(i) For base fee established in the contract at the time of contract award;

(ii) If no base fee is specified in the contract, 30 percent of the amount of each award fee otherwise payable to the Contractor for each award fee evaluation period or at each award fee determination point.

(4) For fixed-price-incentive contracts, the Government may--

(i) Reduce the contract target price and contract target profit both by an amount equal to the initial target profit specified in the contract at the time of contract award; or

(ii) If an immediate adjustment to the contract target price and contract target profit would have a significant adverse impact on the incentive price revision relationship under the contract, or adversely affect the contract financing provisions, the Contracting Officer may defer such adjustment until establishment of the total final price of the contract.

The total final price established in accordance with the incentive price revision provisions of the contract shall be reduced by an amount equal to the initial target profit specified in the contract at the time of contract award and such reduced price shall be the total final contract price.

(5) For firm-fixed price contracts, by 10 percent of the initial contract price or a profit amount determined by the Contracting Officer from records or documents in existence prior to the date of the contract award.

(c) The Government may, at its election, reduce a prime contractor's price or fee in accordance with the procedures of paragraph (b) of this clause for violations of the Act by its subcontractors by an amount not to exceed the amount of profit or fee reflected in the subcontract at the time the subcontract was first definitively priced.

(d) In addition to the remedies in paragraphs (a) and (c) of this clause, the Government may terminate this contract for default. The rights and remedies of the Government specified herein are not exclusive, and are in addition to any other rights and remedies provided by law or under this contract.

(End of clause)

## **8. LIMITATION ON PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (JUN 1997) FAR 52.203-12**

### **(a) Definitions.**

"Agency," as used in this clause, means executive agency as defined in 2.101.

"Covered Federal action," as used in this clause, means any of the following Federal actions:

- (1) The awarding of any Federal contract.
- (2) The making of any Federal grant.
- (3) The making of any Federal loan.
- (4) The entering into of any cooperative agreement.
- (5) The extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

"Indian tribe" and "tribal organization," as used in this clause, have the meaning provided in section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450B) and include Alaskan Natives.

"Influencing or attempting to influence," as used in this clause, means making, with the intent to influence, any communication to or appearance before an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with any covered Federal action.

"Local government," as used in this clause, means a unit of government in a State and, if chartered, established, or otherwise recognized by a State for the performance of a governmental duty, including a local public authority, a special district, an intrastate district, a council of governments, a sponsor group representative organization, and any other instrumentality of a local government.

"Officer or employee of an agency," as used in this clause, includes the following individuals who are employed by an agency:

- (1) An individual who is appointed to a position in the Government under title 5, United States Code, including a position under a temporary appointment.
- (2) A member of the uniformed services, as defined in subsection 101(3), title 37, United States Code.
- (3) A special Government employee, as defined in section 202, title 18, United States Code.
- (4) An individual who is a member of a Federal advisory committee, as defined by the Federal Advisory Committee Act, title 5, United States Code, appendix 2.

"Person," as used in this clause, means an individual, corporation, company, association, authority, firm, partnership, society, State, and local government, regardless of whether such entity is operated for profit, or not for profit. This term excludes an Indian tribe, tribal organization, or any other Indian organization with respect to expenditures specifically permitted by other Federal law.

"Reasonable compensation," as used in this clause, means, with respect to a regularly employed officer or employee of any person, compensation that is consistent with the normal compensation for such officer or employee for work that is not furnished to, not funded by, or not furnished in cooperation with the Federal Government.

"Reasonable payment," as used in this clause, means, with respect to professional and other technical services, a payment in an amount that is consistent with the amount normally paid for such services in the private sector.

"Recipient," as used in this clause, includes the Contractor and all subcontractors. This term excludes an Indian tribe, tribal organization, or any other Indian organization with respect to expenditures specifically permitted by other Federal law.

“Regularly employed,” as used in this clause, means, with respect to an officer or employee of a person requesting or receiving a Federal contract, an officer or employee who is employed by such person for at least 130 working days within 1 year immediately preceding the date of the submission that initiates agency consideration of such person for receipt of such contract. An officer or employee who is employed by such person for less than 130 working days within 1 year immediately preceding the date of the submission that initiates agency consideration of such person shall be considered to be regularly employed as soon as he or she is employed by such person for 130 working days.

“State,” as used in this clause, means a State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, a territory or possession of the United States, an agency or instrumentality of a State, and multi-State, regional, or interstate entity having governmental duties and powers.

(b) *Prohibitions.*

(1) Section 1352 of title 31, United States Code, among other things, prohibits a recipient of a Federal contract, grant, loan, or cooperative agreement from using appropriated funds to pay any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of a Member of Congress in connection with any of the following covered Federal actions: the awarding of any Federal contract; the making of any Federal grant; the making of any Federal loan; the entering into of any cooperative agreement; or the modification of any Federal contract, grant, loan or cooperative agreement.

(2) The Act also requires Contractors to furnish a disclosure if any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with a Federal contract, grant, loan, or cooperative agreement.

(3) The prohibitions of the Act do not apply under the following conditions:

(i) *Agency and legislative liaison by own employees.*

(A) The prohibition on the use of appropriated funds, in subparagraph (b)(1) of this clause, does not apply in the case of a payment of reasonable compensation made to an officer or employee of a person requesting or receiving a covered Federal action if the payment is for agency and legislative liaison activities not directly related to a covered Federal action.

(B) For purposes of subdivision (b)(3)(i)(A) of this clause, providing any information specifically requested by an agency or Congress is permitted at any time.

(C) The following agency and legislative liaison activities are permitted at any time where they are not related to a specific solicitation for any covered Federal action:

(1) Discussing with an agency the qualities and characteristics (including individual demonstrations) of the person’s products or services, conditions or terms of sale, and service capabilities.

(2) Technical discussions and other activities regarding the application or adaptation of the person’s products or services for an agency’s use.

(D) The following agency and legislative liaison activities are permitted where they are prior to formal solicitation of any covered Federal action--

(1) Providing any information not specifically requested but necessary for an agency to make an informed decision about initiation of a covered Federal action;

(2) Technical discussions regarding the preparation of an unsolicited proposal prior to its official submission; and

(3) Capability presentations by persons seeking awards from an agency pursuant to the provisions of the Small Business Act, as amended by Pub. L. 95-507, and subsequent amendments.

(E) Only those services expressly authorized by subdivision (b)(3)(i)(A) of this clause are permitted under this clause.

(ii) *Professional and technical services.*

(A) The prohibition on the use of appropriated funds, in subparagraph (b)(1) of this clause, does not apply in the case of--

(1) A payment of reasonable compensation made to an officer or employee of a person requesting or receiving a covered Federal action or an extension, continuation, renewal, amendment, or modification of a covered Federal action, if payment is for professional or technical services rendered directly in the preparation, submission, or negotiation of any bid, proposal, or application for that Federal

action or for meeting requirements imposed by or pursuant to law as a condition for receiving that Federal action.

- (2) Any reasonable payment to a person, other than an officer or employee of a person requesting or receiving a covered Federal action or an extension, continuation, renewal, amendment, or modification of a covered Federal action if the payment is for professional or technical services rendered directly in the preparation, submission, or negotiation of any bid, proposal, or application for that Federal action or for meeting requirements imposed by or pursuant to law as a condition for receiving that Federal action. Persons other than officers or employees of a person requesting or receiving a covered Federal action include consultants and trade associations.
- (B) For purposes of subdivision (b)(3)(ii)(A) of this clause, “professional and technical services” shall be limited to advice and analysis directly applying any professional or technical discipline. For example, drafting of a legal document accompanying a bid or proposal by a lawyer is allowable. Similarly, technical advice provided by an engineer on the performance of operational capability of a piece of equipment rendered directly in the negotiation of a contract is allowable. However, communications with the intent to influence made by a professional (such as a licensed lawyer) or a technical person (such as a licensed accountant) are not allowable under this section unless they provide advice and analysis directly applying their professional or technical expertise and unless the advice or analysis is rendered directly and solely in the preparation, submission or negotiation of a covered Federal action. Thus, for example, communications with the intent to influence made by a lawyer that do not provide legal advice or analysis directly and solely related to the legal aspects of this or her client’s proposal, but generally advocate one proposal over another are not allowable under this section because the lawyer is not providing professional legal services. Similarly, communications with the intent to influence made by an engineer providing an engineering analysis prior to the preparation or submission of a bid or proposal are not allowable under this section since the engineer is providing technical services but not directly in the preparation, submission or negotiation of a covered Federal action.
- (C) Requirements imposed by or pursuant to law as a condition for receiving a covered Federal award include those required by law or regulation and any other requirements in the actual award documents.
- (D) Only those services expressly authorized by subdivisions (b)(3)(ii)(A)(1) and (2) of this clause are permitted under this clause.
- (E) The reporting requirements of FAR 3.803(a) shall not apply with respect to payments of reasonable compensation made to regularly employed officers or employees of a person.

(c) *Disclosure.*

(1) The Contractor who requests or receives from an agency a Federal contract shall file with that agency a disclosure form, OMB standard form LLL, Disclosure of Lobbying Activities, if such person has made or has agreed to make any payment using nonappropriated funds (to include profits from any covered Federal action), which would be prohibited under subparagraph (b)(1) of this clause, if paid for with appropriated funds.

(2) The Contractor shall file a disclosure form at the end of each calendar quarter in which there occurs any event that materially affects the accuracy of the information contained in any disclosure form previously filed by such person under subparagraph (c)(1) of this clause. An event that materially affects the accuracy of the information reported includes--

(i) A cumulative increase of \$25,000 or more in the amount paid or expected to be paid for influencing are attempting to influence a covered Federal action; or

(ii) A change in the person(s) or individual(s) influencing or attempting to influence a covered Federal action; or

(iii) A change in the officer(s), employee(s), or Member(s) contacted to influence or attempting to influence a covered Federal action.

(3) The Contractor shall require the submittal of a certification, and if required, a disclosure form by any person who requests or receives any subcontract exceeding \$100,000 under the Federal contract.

(4) All subcontractor disclosure forms (but not certifications) shall be forwarded from tier to tier until received by the prime Contractor. The prime Contractor shall submit all disclosures to the Contracting Officer at the end of the

calendar quarter in which the disclosure form is submitted by the subcontractor. Each subcontractor certification shall be retained in the subcontract file of the awarding Contractor.

(d) *Agreement.* The Contractor agrees not to make any payment prohibited by this clause.

(e) *Penalties.*

(1) Any person who makes an expenditure prohibited under paragraph (a) of this clause or who fails to file or amend the disclosure form to be filed or amended by paragraph (b) of this clause shall be subject to civil penalties as provided for by 31 U.S.C. 1352. An imposition of a civil penalty does not prevent the Government from seeking any other remedy that may be applicable.

(2) Contractors may rely without liability on the representation made by their subcontractors in the certification and disclosure form.

(f) *Cost allowability.* Nothing in this clause makes allowable or reasonable any costs which would otherwise be unallowable or unreasonable. Conversely, costs made specifically unallowable by the requirements in this clause will not be made allowable under any other provision.

(End of clause)

## **9. SPECIAL PROHIBITION ON EMPLOYMENT (NOV 1995) DFARS 252.203-7001**

(a) *Definitions.* As used in this clause--

(1) "Arising out of a contract with the DoD" means any act in connection with--

(i) Attempting to obtain,

(ii) Obtaining, or

(iii) Performing a contract or first-tier subcontract of any agency, department, or component of the Department of Defense (DoD).

(2) "Conviction of fraud or any other felony" means any conviction for fraud or a felony in violation of state or Federal criminal statutes, whether entered on a verdict or plea, including a plea of *nolo contendere*, for which sentence has been imposed.

(3) "Date of conviction" means the date judgment was entered against the individual.

(b) 10 U.S.C. 2408 provides that any individual who is convicted after September 29, 1988, of fraud or any other felony arising out of a contract with the DoD is prohibited from:

(1) Working in a management or supervisory capacity on any DoD contract or first-tier subcontract;

(2) Serving on the board of directors of any DoD contractor or first-tier subcontractor; or

(3) Serving as a consultant to any DoD contractor or first-tier subcontractor.

(c) Unless waived, the prohibition in paragraph (b) applies for five years from the date of conviction.

(d) 10 U.S.C. 2408 further provides that a defense contractor or first-tier subcontractor shall be subject to a criminal penalty of not more than \$500,000 if convicted of knowingly--

(1) Employing a person under a prohibition specified in paragraph (b) of this clause; or

(2) Allowing such a person to serve on the board of directors of the contractor or first-tier subcontractor.

(e) In addition to the criminal penalties contained in 10 U.S.C. 2408, the Government may consider other available remedies, such as--

(1) Suspension or debarment;

(2) Cancellation of the contract at no cost to the Government; or

(3) Termination of the contract for default.

(f) The Contractor may submit written requests for waiver of the prohibitions in paragraph (b) of this clause to the Contracting Officer. Requests shall clearly identify--

(1) The person involved;

(2) The nature of the conviction and resultant sentence or punishment imposed;

(3) The reasons for the requested waiver, and

(4) An explanation of why a waiver is in the interest of national security.

(g) The Contractor agrees to include the substance of this clause, appropriately modified to reflect the identity and relationship of the parties, in all first-tier subcontracts exceeding the simplified acquisition threshold in part 13 of the Federal Acquisition Regulation, except those for commercial items or components.

(h) Pursuant to 10 U.S.C. 2408(c), defense contractors and subcontractors may obtain information as to whether a particular person has been convicted of fraud or any other felony arising out of a contract with the DoD by contacting The Office of Justice Programs, The Denial of Benefits Office, U.S. Department of Justice, telephone (202) 307-1065.

(End of clause)

**10. DISPLAY OF DOD HOTLINE POSTER (DEC 1991) DFARS 252.203-7002**

(a) The Contractor shall display prominently in common work areas within business segments performing work under Department of Defense (DoD) contracts, DoD Hotline Posters prepared by the DoD Office of the Inspector General.

(b) DoD Hotline Posters may be obtained from the DoD Inspector General, ATTN: Defense Hotline, 400 Army Navy Drive, Washington, DC 22202-2884.

(c) The Contractor need not comply with paragraph (a) of this clause if it has established a mechanism, such as a hotline, by which employees may report suspected instances of improper conduct, and instructions that encourage employees to make such reports.

(End of clause)

**11. PRINTING/COPYING DOUBLE-SIDED ON RECYCLED PAPER (JUN 1996)  
FAR 52.204-4**

(a) In accordance with Executive Order 12873, dated October 20, 1993, as amended by Executive Order 12995, dated March 25, 1996, the Offeror/Contractor is encouraged to submit paper documents, such as offers, letters, or reports, that are printed/copied double-sided on recycled paper that has at least 20 percent postconsumer material.

(b) The 20 percent standard applies to high-speed copier paper offset paper, forms bond, computer printout paper, carbonless paper, file folders, white woven envelopes, and other uncoated printed and writing paper such as writing and office paper, book paper, cotton fiber paper, and cover stock. An alternative to meeting the 20 percent postconsumer material standards is 50 percent recovered material content of certain industrial by-products.

(End of clause)

**12. REQUIRED CENTRAL CONTRACTOR REGISTRATION (MAR 1998)  
DFARS 52.204-7004**

(a) Definitions. As used in this clause—

(1) Central Contractor Registration (CCR) database means the primary DoD repository for contractor information required for the conduct of business with DoD.

(2) Data Universal Numbering System (DUNS) number means the 9-digit number assigned by Dun and Bradstreet Information Services to identify unique business entities.

(3) Data Universal Numbering System+4 (DUNS+4) number means the DUNS number assigned by Dun and Bradstreet plus a 4-digit suffix that may be assigned by a parent (controlling) business concern. This 4-digit suffix may be assigned at the discretion of the parent business concern for such purposes as identifying subunits or affiliates of the parent business concern.

(4) Registered in the CCR database means that all mandatory information including the DUNS number or the DUNS+4 number, if applicable, and the corresponding Commercial and Government Entity (CAGE) code, is in the CCR database; the DUNS number and the CAGE code have been validated; and all edits have been successfully completed.

(b) (1) By submission of an offer, the offeror acknowledges the requirement that a prospective awardee must be registered in the CCR database prior to award, during the performance, and through final payment of any contract resulting from this solicitation, except for awards to foreign vendors for work to be performed outside the United States.

(2) The offeror shall provide its DUNS or, if applicable, its DUNS+4 number with its offer, which will be used by the Contracting Officer to verify that the offeror is registered in the CCR database.

(3) Lack of registration in the CCR database will make an offer ineligible for award.

(4) DoD has established a goal of registering an applicant in the CCR database within 48 hours after receipt of a complete and accurate application via the Internet. However, registration of an applicant submitting an application through a method other than the Internet may take up to 30 days. Therefore, offerors that are not registered should consider applying for registration immediately upon receipt of this solicitation.

(c) The Contractor is responsible for the accuracy and completeness of the data within the CCR and for any liability resulting from the Government's reliance on inaccurate or incomplete data. To remain registered in the CCR database after initial registration, the Contractor is required to confirm on an annual basis that its information in the CCR database is accurate and complete.

(d) Offerors and contractors may obtain information on registration and annual confirmation requirements by calling 1-888-227-2423, or via the Internet at <http://ccr.edi.disa.mil>.



(End of clause)

**13. PROVISION OF INFORMATION TO COOPERATIVE AGREEMENT HOLDERS  
(DEC 1991) DFARS 252.205-7000**

(a) *Definition.*

“Cooperative agreement holder” means a State or local government; a private, nonprofit organization; a tribal organization (as defined in section 4(c) of the Indian Self-Determination and Education Assistance Act (Pub. L. 93-268; 25 U.S.C. 450(c)); or an economic enterprise (as defined in section 3(e) of the Indian Financing Act of 1974 (Pub. L. 93-362; 25 U.S.C. 1452(e)) whether such economic enterprise is organized for profit or nonprofit purposes; which has an agreement with the Defense Logistics Agency to furnish procurement technical assistance to business entities.

(b) The Contractor shall provide cooperative agreement holders, upon their request, with a list of those appropriate employees or offices responsible for entering into subcontracts under defense contracts. The list shall include the business address, telephone number, and area of responsibility of each employee or office.

(c) The Contractor need not provide the listing to a particular cooperative agreement holder more frequently than once a year.

(End of clause)

**14. PROTECTING THE GOVERNMENT’S INTEREST WHEN SUBCONTRACTING WITH  
CONTRACTORS DEBARRED, SUSPENDED, OR PROPOSED FOR DEBARMENT  
(JUL 1995) FAR 52.209-6**

(a) The Government suspends or debar Contractors to protect the Government’s interests. The Contractor shall not enter into any subcontract in excess of \$25,000 with a Contractor that is debarred, suspended, or proposed for debarment unless there is a compelling reason to do so.

(b) The Contractor shall require each proposed first-tier subcontractor, whose subcontract will exceed \$25,000, to disclose to the Contractor, in writing, whether as of the time of award of the subcontract, the subcontractor, or its principals, is or is not debarred, suspended, or proposed for debarment by the Federal Government.

(c) A corporate officer or a designee of the Contractor shall notify the Contracting Officer, in writing, before entering into a subcontract with a party that is debarred, suspended, or proposed for debarment (see FAR 9.404 for information on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs). The notice must include the following:

(1) The name of the subcontractor.

(2) The Contractor’s knowledge of the reasons for the subcontractor being on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs.

(3) The compelling reasons(s) for doing business with the subcontractor notwithstanding its inclusion on the List of Parties Excluded From Federal Procurement and Nonprocurement Programs.

(4) The systems and procedures the Contractor has established to ensure that it is fully protecting the Government’s interest when dealing with such subcontractor in view of the specific basis for the party’s debarment, suspension, or proposed debarment.

(End of clause)

**15. DEFENSE PRIORITY AND ALLOCATION REQUIREMENTS (SEP 1990)  
FAR 52.211-15**

*NOTE: This clause applies only to military contracts.*

This is a rated order certified for national defense use, and the contractor shall follow all the requirements of the Defense Priorities and Allocations System regulation (15 CFR 700).

(End of clause)

**16. VARIATION IN ESTIMATED QUANTITY (APR 1984) FAR 52.211-18**

If the quantity of a unit-priced item in this contract is an estimated quantity and the actual quantity of the unit-priced item varies more than 15 percent above or below the estimated quantity, an equitable adjustment in the contract price shall be made upon demand of either party. The equitable adjustment shall be based upon any increase or decrease in costs due

solely to the variation above 115 percent or below 85 percent of the estimated quantity. If the quantity variation is such as to cause an increase in the time necessary for completion, the Contractor may request, in writing, an extension of time, to be received by the Contracting Officer within 10 days from the beginning of the delay, or within such further period as may be granted by the Contracting Officer before the date of final settlement of the contract. Upon the receipt of a written request for an extension, the Contracting Officer shall ascertain the facts and make an adjustment for extending the completion date as, in the judgment of the Contracting Officer, is justified.

(End of clause)

#### **17. AUDIT AND RECORDS--SEALED BIDDING (OCT 1997) FAR 52.214-26**

*NOTE: This clause applies only to sealed bid contracts.*

(a) As used in this clause, "records" includes books, documents, accounting procedures and practices, and other data, regardless of type and regardless of whether such items are in written form, in the form of computer data, or in any other form.

(b) *Cost or pricing data.* If the Contractor has been required to submit cost or pricing data in connection with the pricing of any modification to this contract, the Contracting Officer, or an authorized representative of the Contracting Officer, in order to evaluate the accuracy, completeness, and currency of the cost or pricing data, shall have the right to examine and audit all of the Contractor's records, including computations and projections, related to--

- (1) The proposal for the modification;
- (2) The discussions conducted on the proposal(s), including those related to negotiating;
- (3) Pricing of the modification; or
- (4) Performance of the modification.

(c) *Comptroller General.* In the case of pricing any modification, the Comptroller General of the United States, or an authorized representative, shall have the same rights as specified in paragraph (b) of this clause.

(d) *Availability.* The Contractor shall make available at its office at all reasonable times the materials described in paragraph (b) of this clause, for examination, audit, or reproduction, until 3 years after final payment under this contract, or for any other period specified in Subpart 4.7 of the Federal Acquisition Regulation (FAR). FAR Subpart 4.7, Contractor Records Retention, in effect on the date of this contract, is incorporated by reference in its entirety and made a part of this contract.

(1) If this contract is completely or partially terminated, the records relating to the work terminated shall be made available for 3 years after any resulting final termination settlement.

(2) Records pertaining to appeals under the Disputes clause or to litigation or the settlement of claims arising under or relating to the performance of this contract shall be made available until disposition of such appeals, litigation, or claims.

(e) The Contractor shall insert a clause containing all the provisions of this clause, including this paragraph (e), in all subcontracts expected to exceed the threshold in FAR 15.403-4(a)(1) for submission of cost or pricing data.

(End of clause)

#### **18. PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA--MODIFICATIONS--SEALED BIDDING (OCT 1997) FAR 52.214-27**

*NOTE: This clause applies only to sealed bid contracts*

(a) This clause shall become operative only for any modification to this contract involving aggregate increases and/or decreases in costs, plus applicable profits, expected to exceed the threshold for the submission of cost or pricing data at FAR 15.403-4(a)(1), except that this clause does not apply to a modification if an exception under FAR 15.403-1(b) applies.

(b) If any price, including profit, negotiated in connection with any modification under this clause, was increased by any significant amount because (1) the Contractor or a subcontractor furnished cost or pricing data that were not complete, accurate, and current as certified in its Certificate of Current Cost or Pricing Data, (2) a subcontractor or prospective subcontractor furnished the Contractor cost or pricing data that were not complete, accurate, and current as certified in the Contractor's Certificate of Current Cost or Pricing Data, or (3) any of these parties furnished data of any description that were not accurate, the price shall be reduced accordingly and the contract shall be modified to reflect the reduction. This right to a price reduction is limited to that resulting from defects in data relating to modifications for which this clause becomes operative under paragraph (a) of this clause.

(c) Any reduction in the contract price under paragraph (b) of this clause due to defective data from a prospective subcontractor that was not subsequently awarded the subcontract shall be limited to the amount, plus applicable overhead and profit markup, by which (1) the actual subcontract or (2) the actual cost to the Contractor, if there was no subcontract, was less than the prospective subcontract cost estimate submitted by the Contractor; provided, that the actual subcontract price was not itself affected by defective cost or pricing data.

(d)(1) If the Contracting Officer determines under paragraph (b) of this clause that a price or cost reduction should be made, the Contractor agrees not to raise the following matters as a defense:

(i) The Contractor or subcontractor was a sole source supplier or otherwise was in a superior bargaining position and thus the price of the contract would not have been modified even if accurate, complete, and current cost or pricing data had been submitted.

(ii) The Contracting Officer should have known that the cost or pricing data in issue were defective even though the Contractor or subcontractor took no affirmative action to bring the character of the data to the attention of the Contracting Officer.

(iii) The contract was based on an agreement about the total cost of the contract and there was no agreement about the cost of each item procured under the contract.

(iv) The Contractor or subcontractor did not submit a Certificate of Current Cost or Pricing Data.

(2)(i) Except as prohibited by subdivision (d)(2)(ii) of this clause, an offset in an amount determined appropriate by the Contracting Officer based upon the facts shall be allowed against the amount of a contract price reduction if--

- (A) The Contractor certifies to the Contracting Officer that, to the best of the Contractor's knowledge and belief, the Contractor is entitled to the offset in the amount requested; and
- (B) The Contractor proves that the cost or pricing data were available before the date of agreement on the price of the contract (or price of the modification) and that the data were not submitted before such date.

(ii) An offset shall not be allowed if--

- (A) The understated data was known by the Contractor to be understated when the Certificate of Current Cost or Pricing Data was signed; or
- (B) The Government proves that the facts demonstrate that the contract price would not have increased in the amount to be offset even if the available data has been submitted before the date of agreement on price.

(e) If any reduction in the contract price under this clause reduces the price of items for which payment was made prior to the date of the modification reflecting the price reduction, the Contractor shall be liable to and shall pay the United States at the time such overpayment is repaid--

(1) Simple interest on the amount of such overpayment to be computed from the date(s) of overpayment to the Contractor to the date the Government is repaid by the Contractor at the applicable underpayment rate effective for each quarter prescribed by the Secretary of the Treasury under 26 U.S.C. 6621 (a)(2); and

(2) A penalty equal to the amount of the overpayment, if the Contractor or subcontractor knowingly submitted cost or pricing data which were incomplete, inaccurate, or noncurrent.

(End of clause)

## **19. SUBCONTRACTOR COST OR PRICING DATA--MODIFICATIONS-SEALED BIDDING (OCT 1997) FAR 52.214-28**

*NOTE: This clause applies only to sealed bid contracts.*

(a) The requirements of paragraphs (b) and (c) of this clause shall (1) become operative only for any modification to this contract involving aggregate increases and/or decreases in costs, plus applicable profits, expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4(a)(1), and (2) be limited to such modifications.

(b) Before awarding any subcontract expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4(a)(1), on the date of agreement on price or the date of award, whichever is later; or before pricing any subcontract modifications involving aggregate increases and/or decreases in costs, plus applicable profits, expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4(a)(1), the Contractor shall require the subcontractor to submit cost or pricing data (actually or by specified identification in writing), unless an exception under FAR 15.403-1(b) applies.

(c) The Contractor shall require the subcontractor to certify in substantially the form prescribed in subsection FAR 15.406-2 that, to the best of its knowledge and belief, the data submitted under paragraph (b) of this clause were accurate, complete, and current as of the date of agreement on the negotiated price of the subcontract or subcontract modification.

(d) The Contractor shall insert the substance of this clause, including this paragraph (d), in each subcontract that, when entered into, exceeds the threshold for submission of cost or pricing data at FAR 15.403-4(a)(1).

(End of clause)

## **20. AUDIT AND RECORDS--NEGOTIATION (AUG 1996) FAR 52.215-2**

*NOTE: This clause applies only to negotiated contracts.*

(a) As used in this clause, "records" includes books, documents, accounting procedures and practices, and other data, regardless of type and regardless of whether such items are in written form, in the form of computer data, or in any other form.

(b) *Examination of costs.* If this is a cost-reimbursement, incentive, time-and-materials, labor-hour, or price redeterminable contract, or any combination of these, the Contractor shall maintain and the Contracting Officer, or an authorized representative of the Contracting Officer, shall have the right to examine and audit all records and other evidence sufficient to reflect properly all costs claimed to have been incurred or anticipated to be incurred directly or indirectly in performance of this contract. This right of examination shall include inspection at all reasonable times of the Contractor's plants, or parts of them, engaged in performing the contract.

(c) *Cost or pricing data.* If the Contractor has been required to submit cost or pricing data in connection with any pricing action relating to this contract, the Contracting Officer, or an authorized representative of the Contracting Officer, in order to evaluate the accuracy, completeness, and currency of the cost or pricing data, shall have the right to examine and audit all of the Contractor's records, including computations and projections, related to--

- (1) The proposal for the contract, subcontract, or modification;
- (2) The discussions conducted on the proposal(s), including those related to negotiating;
- (3) Pricing of the contract, subcontract, or modification; or
- (4) Performance of the contract, subcontract or modification.

(d) *Comptroller General.*--(1) The Comptroller General of the United States, or an authorized representative, shall have access to and the right to examine any of the Contractor's directly pertinent records involving transactions related to this contract or a subcontract hereunder.

(2) This paragraph may not be construed to require the Contractor or subcontractor to create or maintain any record that the Contractor or subcontractor does not maintain in the ordinary course of business or pursuant to a provision of law.

(e) *Reports.* If the Contractor is required to furnish cost, funding, or performance reports, the Contracting Officer or an authorized representative of the Contracting Officer shall have the right to examine and audit the supporting records and materials, for the purpose of evaluating (1) the effectiveness of the Contractor's policies and procedures to produce data compatible with the objectives of these reports and (2) the data reported.

(f) *Availability.* The Contractor shall make available at its office at all reasonable times the records, materials, and other evidence described in paragraphs (a), (b), (c), (d), and (e) of this clause, for examination, audit, or reproduction, until 3 years after final payment under this contract, or for any shorter period specified in Subpart 4.7, Contractor Records Retention, of the Federal Acquisition Regulation (FAR), or for any longer period required by statute or by other clauses of this contract. In addition--

(1) If this contract is completely or partially terminated, the records relating to the work terminated shall be made available for 3 years after any resulting final termination settlement; and

(2) Records relating to appeals under the Disputes clause or to litigation or the settlement of claims arising under or relating to this contract shall be made available until such appeals, litigation, or claims are finally resolved.

(g) The Contractor shall insert a clause containing all the terms of this clause, including this paragraph (g), in all subcontracts under this contract that exceed the simplified acquisition threshold, and--

- (1) That are cost-reimbursement, incentive, time-and-materials, labor-hour, or price-redeterminable type or any combination of these;
- (2) For which cost or pricing data are required; or
- (3) That require the subcontractor to furnish reports as discussed in paragraph (c) of this clause.

The clause may be altered only as necessary to identify properly the contracting parties and the Contracting Officer under the Government prime contract.

(End of clause)

## **21. PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA (OCT 1997) FAR 52.215-10**

*NOTE: This clause applies only to negotiated contracts.*

(a) If any price, including profit or fee, negotiated in connection with this contract, or any cost reimbursable under this contract, was increased by any significant amount because --(1) The Contractor or a subcontractor furnished cost or pricing data that were not complete, accurate, and current as certified in its Certificate of Current Cost or Pricing Data; (2) A subcontractor or prospective subcontractor furnished the Contractor cost or pricing data that were not complete, accurate, and current as certified in the Contractor's Certificate of Current Cost or Pricing Data, or (3) Any of these parties furnished data of any description that were not accurate, the price or cost shall be reduced accordingly and the contract shall be modified to reflect the reduction.

(b) Any reduction in the contract price under paragraph (a) of this clause due to defective data from a prospective subcontractor that was not subsequently awarded the subcontract shall be limited to the amount, plus applicable overhead and profit markup, by which (1) The actual subcontract; or (2) The actual cost to the Contractor, if there was no subcontract, was less than the prospective subcontract cost estimate submitted by the Contractor; provided, that the actual subcontract price was not itself affected by defective cost or pricing data.

(c)(1) If the Contracting Officer determines under paragraph (a) of this clause that a price or cost reduction should be made, the Contractor agrees not to raise the following matters as a defense:

(i) The Contractor or subcontractor was a sole source supplier or otherwise was in a superior bargaining position and thus the price of the contract would not have been modified even if accurate, complete, and current cost or pricing data had been submitted.

(ii) The Contracting Officer should have known that the cost or pricing data in issue were defective even though the Contractor or subcontractor took no affirmative action to bring the character of the data to the attention of the Contracting Officer.

(iii) The contract was based on an agreement about the total cost of the contract and there was no agreement about the cost of each item procured under the contract.

(iv) The Contractor or subcontractor did not submit a Certificate of Current Cost or Pricing Data.

(2)(i) Except as prohibited by subdivision (c)(2)(ii) of this clause, an offset in an amount determined appropriate by the Contracting Officer based upon the facts shall be allowed against the amount of a contract price reduction if--

- (A) The Contractor certifies to the Contracting Officer that, to the best of the Contractor's knowledge and belief, the Contractor is entitled to the offset in the amount requested; and
- (B) The Contractor proves that the cost or pricing data were available before the "as of" date specified on its Certificate of Current Cost or Pricing Data, and that the data were not submitted before such date

(ii) An offset shall not be allowed if--

- (A) The understated data was known by the Contractor to be understated before the "as of" date specified on its Certificate of Current Cost or Pricing Data; or
- (B) The Government proves that the facts demonstrate that the contract price would not have increased in the amount to be offset even if the available data has been submitted before the "as of" date specified on its Certificate of Current Cost or Pricing Data.

(d) If any reduction in the contract price under this clause reduces the price of items for which payment was made prior to the date of the modification reflecting the price reduction, the Contractor shall be liable to and shall pay the United States at the time such overpayment is repaid--

(1) Simple interest on the amount of such overpayment to be computed from the date(s) of overpayment to the Contractor to the date the Government is repaid by the Contractor at the applicable under payment rate effective for each quarter prescribed by the Secretary of the Treasury under 26 U.S.C. 6621(a)(2); and

(2) A penalty equal to the amount of the overpayment, if the Contractor or subcontractor knowingly submitted cost or pricing data which were incomplete, inaccurate, or noncurrent.

(End of clause)

## **22. SUBCONTRACTOR COST OR PRICING DATA (OCT 1997) FAR 52.215-12**

*NOTE: This clause applies only to negotiated contracts.*

(a) Before awarding any subcontract expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4, on the date of agreement on price or the date of award, whichever is later; or before pricing any subcontract modification involving a pricing adjustment expected to exceed the threshold for submission of cost or pricing data at FAR

15.403-4, the Contractor shall require the subcontractor to submit cost or pricing data (actually or by specific identification in writing), unless an exception under FAR 15.403-1 applies.

(b) The Contractor shall require the subcontractor to certify in substantially the form prescribed in subsection 15.406-2 that, to the best of its knowledge and belief, the data submitted under paragraph (a) of this clause were accurate, complete, and current as of the date of agreement on the negotiated price of the subcontract or subcontract modification.

(c) In each subcontract that exceeds the threshold for submission of cost or pricing data at FAR 15.403-4, when entered into, the Contractor shall insert either--

(1) The substance of this clause, including this paragraph (c), if paragraph (a) of this clause requires submission of cost or pricing data for the subcontract; or

(2) The substance of the clause at FAR 52.215-13, Subcontractor Cost or Pricing Data--Modifications.

(End of clause)

## **23. TERMINATION OF DEFINED BENEFIT PENSION PLANS (OCT 1997) FAR 52.215-15**

*NOTE: This clause applies only to negotiated contracts.*

The Contractor shall promptly notify the Contracting Officer in writing when it determines that it will terminate a defined benefit pension plan or otherwise recapture such pension fund assets. If pension fund assets revert to the Contractor or are constructively received by it under a termination or otherwise, the Contractor shall make a refund or give a credit to the Government for its equitable share as required by FAR 31.205-6(j)(4). The Contractor shall include the substance of this clause in all subcontracts under this contract which meet the applicability requirements of FAR 15.408(g).

(End of clause)

## **24. REVERSION OR ADJUSTMENT OF PLANS FOR POSTRETIREMENT BENEFITS (PRB) OTHER THAN PENSIONS (OCT 1997) FAR 52.215-18**

*NOTE: This clause applies only to negotiated contracts.*

The Contractor shall promptly notify the Contracting Officer in writing when it determines that it will terminate or reduce a PRB plan. If PRB fund assets revert, or inure, to the Contractor or are constructively received by it under a plan termination or otherwise, the Contractor shall make a refund or give a credit to the Government for its equitable share as required by FAR 31.205-6(o)(6). The Contractor shall include the substance of this clause in all subcontracts under this contract which meet the applicability requirements of FAR 15.408(j)

(End of clause)

## **25. NOTIFICATION OF OWNERSHIP CHANGES (OCT 1997) FAR 52.215-19**

*NOTE: This clause applies only to negotiated contracts.*

(a) The Contractor shall make the following notifications in writing:

(1) When the Contractor becomes aware that a change in its ownership has occurred, or is certain to occur, which could result in changes in the valuation of its capitalized assets in the accounting records, the Contractor shall notify the Administrative Contracting Officer (ACO) within 30 days.

(2) The Contractor shall also notify the ACO within 30 days whenever changes to asset valuations or any other cost changes have occurred or are certain to occur as a result of a change in ownership.

(b) The Contractor shall-- (1) Maintain current, accurate, and complete inventory records of assets and their costs; (2) Provide the ACO or designated representative ready access to the records upon request; (3) Ensure that all individual and grouped assets, their capitalized values, accumulated depreciation or amortization, and remaining useful lives are identified accurately before and after each of the Contractor's ownership changes; and (4) Retain and continue to maintain depreciation and amortization schedules based on the asset records maintained before each Contractor ownership change.

(c) The Contractor shall include the substance of this clause in all subcontracts under this contract which meet the applicability requirement of FAR 15.408(k).

(End of clause)

## **26. PRICING ADJUSTMENTS (DEC 1991) DFARS 252.215-7000**

*NOTE: This clause applies only to negotiated contracts.*

The term "pricing adjustment," as used in paragraph (a) of the clauses entitled "Price Reduction for Defective Cost or Pricing Data - Modifications," "Subcontractor Cost or Pricing Data," and "Subcontractor Cost or Pricing Data - Modifications," means the aggregate increases and/or decreases in cost plus applicable profits.

(End of clause)

**27. UTILIZATION OF SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS CONCERNS (JUN 1997) FAR 52.219-8**

(a) It is the policy of the United States that small business concerns, small business concerns owned and controlled by socially and economically disadvantaged individuals and small business concerns owned and controlled by women shall have the maximum practicable opportunity to participate in performing contracts let by any Federal agency, including contracts and subcontracts for subsystems, assemblies, components, and related services for major systems. It is further the policy of the United States that its prime contractors establish procedures to ensure the timely payment of amounts due pursuant to the terms of their subcontracts with small business concerns, small business concerns owned and controlled by socially and economically disadvantaged individuals and small business concerns owned and controlled by women.

(b) The Contractor hereby agrees to carry out this policy in the awarding of subcontracts to the fullest extent consistent with efficient contract performance. The Contractor further agrees to cooperate in any studies or surveys as may be conducted by the United States Small Business Administration or the awarding agency of the United States as may be necessary to determine the extent of the Contractor's compliance with this clause.

(c) As used in this contract, the term "small business concern" shall mean a small business as defined pursuant to section 3 of the Small Business Act and relevant regulations promulgated pursuant thereto. The term "small business concern owned and controlled by socially and economically disadvantaged individuals" shall mean a small business concern (1) which is at least 51 percent unconditionally owned by one or more socially and economically disadvantaged individuals; or, in the case of any publicly owned business, at least 51 percent of the stock of which is unconditionally owned by one or more socially and economically disadvantaged individuals; and (2) whose management and daily business operations are controlled by one or more of such individuals. This term also means a small business concern that is at least 51 percent unconditionally owned by an economically disadvantaged Indian tribe or Native Hawaiian Organization, or a publicly owned business having at least 51 percent of its stock unconditionally owned by one of these entities which has its management and daily business controlled by members of an economically disadvantaged Indian tribe or Native Hawaiian Organization, and which meets the requirements of 13 CFR 124. The Contractor shall presume that socially and economically disadvantaged individuals include Black Americans, Hispanic Americans, Native Americans, Asian-Pacific Americans, Subcontinent Asian Americans, and other minorities, or any other individual found to be disadvantaged by the Administration pursuant to section 8(a) of the Small Business Act. The Contractor shall presume that socially and economically disadvantaged entities also include Indian Tribes and Native Hawaiian Organizations.

(d) The term "small business concern owned and controlled by women" shall mean a small business concern (1) which is at least 51 percent owned by one or more women, or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women, and (2) whose management and daily business operations are controlled by one or more women; and

(e) Contractors acting in good faith may rely on written representations by their subcontractors regarding their status as a small business concern, a small business concern owned and controlled by socially and economically disadvantaged individuals or a small business concern owned and controlled by women.

(End of clause)

**28. SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS SUBCONTRACTING PLAN (AUG 1996) FAR 52.219-9**

*NOTE: This clause applies to negotiated solicitations over \$1,000,000.00. See also FAR 52.219-9 II below*

(a) This clause does not apply to small business concerns.

(b) "Commercial product," as used in this clause, means a product in regular production that is sold in substantial quantities to the general public and/or industry at established catalog or market prices. It also means a product which, in the opinion of the Contracting Officer, differs only insignificantly from the Contractor's commercial product.

“Subcontract,” as used in this clause, means any agreement (other than one involving an employer-employee relationship) entered into by a Federal Government prime Contractor or subcontractor calling for supplies or services required for performance of the contract or subcontract.

(c) The offeror, upon request by the Contracting Officer, shall submit and negotiate a subcontracting plan, where applicable, which separately addresses subcontracting with small business concerns, with small disadvantaged business concerns and with women-owned small business concerns. If the offeror is submitting an individual contract plan, the plan must separately address subcontracting with small business concerns, small disadvantaged business concerns, and women-owned small business concerns with a separate part for the basic contract and separate parts for each option (if any). The plan shall be included in and made a part of the resultant contract. The subcontracting plan shall be negotiated within the time specified by the Contracting Officer. Failure to submit and negotiate the subcontracting plan shall make the offeror ineligible for award of a contract.

(d) The offeror’s subcontracting plan shall include the following:

(1) Goals, expressed in terms of percentages of total planned subcontracting dollars, for the use of small business concerns, small disadvantaged business concerns and women-owned small business concerns as subcontractors. The offeror shall include all subcontracts that contribute to contract performance, and may include a proportionate share of products and services that are normally allocated as indirect costs.

(2) A statement of--

(i) Total dollars planned to be subcontracted;

(ii) Total dollars planned to be subcontracted to small business concerns;

(iii) Total dollars planned to be subcontracted to small disadvantaged business concerns; and

(iv) Total dollars planned to be subcontracted to women-owned small business concerns.

(3) A description of the principal types of supplies and services to be subcontracted, and an identification of the types planned for subcontracting to (i) small business concerns, (ii) small disadvantaged business concerns and (iii) women-owned small business concerns.

(4) A description of the method used to develop the subcontracting goals in paragraph (d)(1) of this clause.

(5) A description of the methods used to identify potential sources for solicitation purposes (e.g., existing company source lists, the Procurement Automated Source System (PASS) of the Small Business Administration, the National Minority Purchasing Council Vendor Information Service, the Research and Information Division of the Minority Business Development Agency in the Department of Commerce, or small, small disadvantaged and women-owned small business concerns trade associations). A firm may rely on the information contained in PASS as an accurate representation of a concern’s size and ownership characteristics for purposes of maintaining a small business source list. A firm may rely on PASS as its small business source list. Use of the PASS as its source list does not relieve a firm of its responsibilities (e.g., outreach, assistance, counseling, publicizing subcontracting opportunities) in this clause.

(6) A statement as to whether or not the offeror included indirect costs in establishing subcontracting goals, and a description of the method used to determine the proportionate share of indirect costs to be incurred with (i) small business concerns, (ii) small disadvantaged business concerns, and (iii) women-owned small business concerns.

(7) The name of the individual employed by the offeror who will administer the offeror’s subcontracting program, and a description of the duties of the individual.

(8) A description of the efforts the offeror will make to assure that small, small disadvantaged and women-owned small business concerns have an equitable opportunity to compete for subcontracts.

(9) Assurance that the offeror will include the clause in this contract entitled “Utilization of Small, Small Disadvantaged and Women-Owned Small Business Concerns” in all subcontracts that offer further subcontracting opportunities, and that the offeror will require all subcontractors (except small business concerns) who receive subcontracts in excess of \$500,000 (\$1,000,000 for construction of any public facility) to adopt a plan similar to the plan agreed to by the offeror.

(10) Assurances that the offeror will (i) cooperate in any studies or surveys as may be required, (ii) submit periodic reports in order to allow the Government to determine the extent of compliance by the offeror with the subcontracting plan, (iii) submit Standard Form (SF) 294, Subcontracting Report for Individual Contracts, and/or SF 295, Summary Subcontract Report, in accordance with the instructions on the forms, and (iv) ensure that its subcontractors agree to submit Standard Forms 294 and 295.

(11) A recitation of the types of records the offeror will maintain to demonstrate procedures that have been adopted to comply with the requirements and goals in the plan, including establishing source lists; and a description of its efforts to locate small, small disadvantaged and women-owned small business concerns and award subcontracts to them. The records shall include at least the following (on a plant-wide or company-wide basis, unless otherwise indicated):

(i) Source lists (e.g., PASS), guides, and other data that identify small, small disadvantaged and women-owned small business concerns.



(ii) Organizations contacted in an attempt to locate sources that are small, small disadvantaged or women-owned small business concerns.

(iii) Records on each subcontract solicitation resulting in an award of more than \$100,000, indicating (A) whether small business concerns were solicited and if not, why not, (B) whether small disadvantaged business concerns were solicited and if not, why not, (C) whether women-owned small business concerns were solicited and if not, why not, and (D) if applicable, the reason award was not made to a small business concern.

(iv) Records of any outreach efforts to contact (A) trade associations, (B) business development organizations, and (C) conferences and trade fairs to locate small, small disadvantaged and women-owned small business sources.

(v) Records of internal guidance and encouragement provided to buyers through (A) workshops, seminars, training, etc., and (B) monitoring performance to evaluate compliance with the program's requirements.

(vi) On a contract-by-contract basis, records to support award data submitted by the offeror to the Government, including the name, address, and business size of each subcontractor. Contractors having company or division-wide annual plans need not comply with this requirement.

(e) In order to effectively implement this plan to the extent consistent with efficient contract performance, the Contractor shall perform the following functions:

(1) Assist small, small disadvantaged and women-owned small business concerns by arranging solicitations, time for the preparation of bids, quantities, specifications, and delivery schedules so as to facilitate the participation by such concerns. Where the contractor's lists of potential small, small disadvantaged and women-owned small business subcontractors are excessively long, reasonable effort shall be made to give all such small business concerns an opportunity to compete over a period of time.

(2) Provide adequate and timely consideration of the potentialities of small, small disadvantaged and women-owned small business concerns in all "make-or-buy" decisions.

(3) Counsel and discuss subcontracting opportunities with representative of small, small disadvantaged and women-owned small business firms.

(4) Provide notice to subcontractors concerning penalties and remedies for misrepresentations of business status as small, small disadvantaged or women-owned small business for the purpose of obtaining a subcontract that is to be included as part or all of a goal contained in the Contractor's subcontracting plan.

(f) A master subcontracting plan on a plant or division-wide basis which contains all the elements required by (d) above, except goals, may be incorporated by reference as a part of the subcontracting plan required of the offeror by this clause; provided, (1) the master plan has been approved, (2) the offeror ensures that the master plan is updated as necessary and provides copies of the approved master plan, including evidence of its approval, to the Contracting Officer, and (3) goals and any deviations from the master plan deemed necessary by the Contracting Officer to satisfy the requirements of this contract are set forth in the individual subcontracting plan.

(g)(1) If a commercial product is offered, the subcontracting plan required by this clause may relate to the offeror's production generally, for both commercial and non-commercial products, rather than solely to the Government contract. In these cases, the offeror shall, with the concurrence of the Contracting Officer, submit one company-wide or division-wide annual plan.

(2) The annual plan shall be reviewed for approval by the agency awarding the offeror its first prime contract requiring a subcontracting plan during the fiscal year, or by an agency satisfactory to the Contracting Officer.

(3) The approved plan shall remain in effect during the offeror's fiscal year for all of the offeror's commercial products.

(h) Prior compliance of the offeror with other such subcontracting plans under previous contracts will be considered by the Contracting Officer in determining the responsibility of the offeror for award of the contract.

(i) The failure of the Contractor or subcontractor to comply in good faith with (1) the clause of this contract entitled "Utilization of Small, Small Disadvantaged and Women-Owned Small Business Concerns," or (2) an approved plan required by this clause, shall be a material breach of the contract.

(End of clause)

**29. SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS  
SUBCONTRACTING PLAN (AUG 1996) ALTERNATE I (OCT 1995) FAR 52.219-9 I**

*NOTE: This clause applies only to sealed-bid solicitations over \$1,000,000.00.*

(a) This clause does not apply to small business concerns.

(b) "Commercial product," as used in this clause, means a product in regular production that is sold in substantial quantities to the general public and/or industry at established catalog or market prices. It also means a product which, in the opinion of the Contracting Officer, differs only insignificantly from the Contractor's commercial product.

"Subcontract," as used in this clause, means any agreement (other than one involving an employer-employee relationship) entered into by a Federal Government prime Contractor or subcontractor calling for supplies or services required for performance of the contract or subcontract.

(c) The apparent low bidder, upon request by the Contracting Officer, shall submit a subcontracting plan, where applicable, which separately addresses subcontracting with small business concerns, with small disadvantaged business concerns and with women-owned small business concerns. If the bidder is submitting an individual contract plan, the plan must separately address subcontracting with small business concerns, small disadvantaged business concerns, and women-owned small business concerns, with a separate part for the basic contract and separate parts for each option (if any). The plan shall be included in and made a part of the resultant contract. The subcontracting plan shall be submitted within the time specified by the Contracting Officer. Failure to submit the subcontracting plan shall make the bidder ineligible for the award of a contract.

(d) The offeror's subcontracting plan shall include the following:

(1) Goals, expressed in terms of percentages of total planned subcontracting dollars, for the use of small business concerns, small disadvantaged business concerns and women-owned small business concerns as subcontractors. The offeror shall include all subcontracts that contribute to contract performance, and may include a proportionate share of products and services that are normally allocated as indirect costs.

(2) A statement of--

(i) Total dollars planned to be subcontracted;

(ii) Total dollars planned to be subcontracted to small business concerns;

(iii) Total dollars planned to be subcontracted to small disadvantaged business concerns; and

(iv) Total dollars planned to be subcontracted to women-owned small business concerns.

(3) A description of the principal types of supplies and services to be subcontracted, and an identification of the types planned for subcontracting to (i) small business concerns, (ii) small disadvantaged business concerns and (iii) women-owned small business concerns.

(4) A description of the method used to develop the subcontracting goals in paragraph (d)(1) of this clause.

(5) A description of the methods used to identify potential sources for solicitation purposes (e.g., existing company source lists, the Procurement Automated Source System (PASS) of the Small Business Administration, the National Minority Purchasing Council Vendor Information Service, the Research Information Division of the Minority Business Development Agency in the Department of Commerce, or small, small disadvantaged and women-owned small business concerns trade associations). A firm may rely on the information contained in PASS as an accurate representation of a concern's size and ownership characteristics for purposes of maintaining a small business source list. A firm may rely on PASS as its small business source list. Use of the PASS as its source list does not relieve a firm of its responsibilities (e.g., outreach, assistance, counseling, publicizing subcontracting opportunities) in this clause.

(6) A statement as to whether or not the offeror included indirect costs in establishing subcontracting goals, and a description of the method used to determine the proportionate share of indirect costs to be incurred with (i) small business concerns, (ii) small disadvantaged business concerns, and (iii) women-owned small business concerns.

(7) The name of the individual employed by the offeror who will administer the offeror's subcontracting program, and a description of the duties of the individual.

(8) A description of the efforts the offeror will make to assure that small, small disadvantaged and women-owned small business concerns have an equitable opportunity to compete for subcontracts.

(9) Assurance that the offeror will include the clause in this contract entitled "Utilization of Small, Small Disadvantaged and Women-Owned Small Business Concerns" in all subcontracts that offer further subcontracting opportunities, and that the offeror will require all subcontractors (except small business concerns) who receive subcontracts in excess of \$500,000 (\$1,000,000 for construction of any public facility) to adopt a plan similar to the plan agreed to by the offeror.

(10) Assurances that the offeror will (i) cooperate in any studies or surveys as may be required, (ii) submit periodic reports in order to allow the Government to determine the extent of compliance by the offeror with the subcontracting plan, (iii) submit Standard Form (SF) 294, Subcontracting Report for Individual Contracts, and/or SF 295, Summary Subcontract Report, in accordance with the instructions on the forms, and (iv) ensure that its subcontractors agree to submit Standard Forms 294 and 295.

(11) A recitation of the types of records the offeror will maintain to demonstrate procedures that have been adopted to comply with the requirements and goals in the plan, including establishing source lists; and a description of its

efforts to locate small, small disadvantaged and women-owned small business concerns and award subcontracts to them. The records shall include at least the following (on a plant-wide or company-wide basis, unless otherwise indicated):

(i) Source lists (e.g., PASS), guides, and other data that identify small, small disadvantaged and women-owned small business concerns.

(ii) Organizations contacted in an attempt to locate sources that are small, small disadvantaged or women-owned small business concerns.

(iii) Records on each subcontract solicitation resulting in an award of more than \$100,000, indicating (A) whether small business concerns were solicited and if not, why not, (B) whether small disadvantaged business concerns were solicited and if not, why not, (C) whether women-owned small business concerns were solicited and if not, why not, and (D) if applicable, the reason award was not made to a small business concern.

(iv) Records of any outreach efforts to contact (A) trade associations, (B) business development organizations, and (C) conferences and trade fairs to locate small, small disadvantaged and women-owned small business sources.

(v) Records of internal guidance and encouragement provided to buyers through (A) workshops, seminars, training, etc., and (B) monitoring performance to evaluate compliance with the program's requirements.

(vi) On a contract-by-contract basis, records to support award data submitted by the offeror to the Government, including the name, address, and business size of each subcontractor. Contractors having company or division-wide annual plans need not comply with this requirement.

(e) In order to effectively implement this plan to the extent consistent with efficient contract performance, the Contractor shall perform the following functions:

(1) Assist small, small disadvantaged and women-owned small business concerns by arranging solicitations, time for the preparation of bids, quantities, specifications, and delivery schedules so as to facilitate the participation by such concerns. Where the contractor's lists of potential small, small disadvantaged and women-owned small business subcontractors are excessively long, reasonable effort shall be made to give all such small business concerns an opportunity to compete over a period of time.

(2) Provide adequate and timely consideration of the potentialities of small, small disadvantaged and women-owned small business concerns in all "make-or-buy" decisions.

(3) Counsel and discuss subcontracting opportunities with representative of small, small disadvantaged and women-owned small business firms.

(4) Provide notice to subcontractors concerning penalties and remedies for misrepresentations of business status as small, small disadvantaged or women-owned small business for the purpose of obtaining a subcontract that is to be included as part or all of a goal contained in the Contractor's subcontracting plan.

(f) A master subcontracting plan on a plant or division-wide basis which contains all the elements required by (d) above, except goals, may be incorporated by reference as a part of the subcontracting plan required of the offeror by this clause; provided, (1) the master plan has been approved, (2) the offeror ensures that the master plan is updated as necessary and provides copies of the approved master plan, including evidence of its approval, to the Contracting Officer, and (3) goals and any deviations from the master plan deemed necessary by the Contracting Officer to satisfy the requirements of this contract are set forth in the individual subcontracting plan.

(g)(1) If a commercial product is offered, the subcontracting plan required by this clause may relate to the offeror's production generally, for both commercial and non-commercial products, rather than solely to the Government contract. In these cases, the offeror shall, with the concurrence of the Contracting Officer, submit one company-wide or division-wide annual plan.

(2) The annual plan shall be reviewed for approval by the agency awarding the offeror its first prime contract requiring a subcontracting plan during the fiscal year, or by an agency satisfactory to the Contracting Officer.

(3) The approved plan shall remain in effect during the offeror's fiscal year for all of the offeror's commercial products.

(h) Prior compliance of the offeror with other such subcontracting plans under previous contracts will be considered by the Contracting Officer in determining the responsibility of the offeror for award of the contract.

(i) The failure of the Contractor or subcontractor to comply in good faith with (1) the clause of this contract entitled "Utilization of Small, Small Disadvantaged and Women-Owned Small Business Concerns," or (2) an approved plan required by this clause, shall be a material breach of the contract.

(End of clause)

**30. SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS  
SUBCONTRACTING PLAN (AUG 1996) ALTERNATE II (MAR 1996)  
FAR 52.219-9 II**

*NOTE: This clause applies only to negotiated solicitations over \$1,000,000, when a subcontracting plan is required with the initial proposal as described in Sections 00110 & 00115.*

(a) This clause does not apply to small business concerns.

(b) "Commercial product," as used in this clause, means a product in regular production that is sold in substantial quantities to the general public and/or industry at established catalog or market prices. It also means a product which, in the opinion of the Contracting Officer, differs only insignificantly from the Contractor's commercial product.

"Subcontract," as used in this clause, means any agreement (other than one involving an employer-employee relationship) entered into by a Federal Government prime Contractor or subcontractor calling for supplies or services required for performance of the contract or subcontract.

(c) Proposals submitted in response to this solicitation shall include a subcontracting plan, which separately addresses subcontracting with small business concerns, small disadvantaged business concerns and women-owned small business concerns. If the offeror is submitting an individual contract plan, the plan must separately address subcontracting with small business concerns, small disadvantaged business concerns and women-owned small business concerns with a separate part for the basic contract and separate parts for each option (if any). The plan shall be included in and made a part of the resultant contract. The subcontracting plan shall be negotiated within the time specified by the Contracting Officer. Failure to submit and negotiate a subcontracting plan shall make the offeror ineligible for award of a contract.

(d) The offeror's subcontracting plan shall include the following:

(1) Goals, expressed in terms of percentages of total planned subcontracting dollars, for the use of small business concerns, small disadvantaged business concerns and women-owned small business concerns as subcontractors. The offeror shall include all subcontracts that contribute to contract performance, and may include a proportionate share of products and services that are normally allocated as indirect costs.

(2) A statement of--

(i) Total dollars planned to be subcontracted;

(ii) Total dollars planned to be subcontracted to small business concerns;

(iii) Total dollars planned to be subcontracted to small disadvantaged business concerns; and

(iv) Total dollars planned to be subcontracted to women-owned small business concerns.

(3) A description of the principal types of supplies and services to be subcontracted, and an identification of the types planned for subcontracting to (i) small business concerns, (ii) small disadvantaged business concerns and (iii) women-owned small business concerns.

(4) A description of the method used to develop the subcontracting goals in paragraph (d)(1) of this clause.

(5) A description of the methods used to identify potential sources for solicitation purposes (e.g., existing company source lists, the Procurement Automated Source System (PASS) of the Small Business Administration, the National Minority Purchasing Council Vendor Information Service, the Research Information Division of the Minority Business Development Agency in the Department of Commerce, or small, small disadvantaged and women-owned small business concerns trade associations). A firm may rely on the information contained in PASS as an accurate representation of a concern's size and ownership characteristics for purposes of maintaining a small business source list. A firm may rely on PASS as its small business source list. Use of the PASS as its source list does not relieve a firm of its responsibilities (e.g., outreach, assistance, counseling, publicizing subcontracting opportunities) in this clause.

(6) A statement as to whether or not the offeror included indirect costs in establishing subcontracting goals, and a description of the method used to determine the proportionate share of indirect costs to be incurred with (i) small business concerns, (ii) small disadvantaged business concerns, and (iii) women-owned small business concerns.

(7) The name of the individual employed by the offeror who will administer the offeror's subcontracting program, and a description of the duties of the individual.

(8) A description of the efforts the offeror will make to assure that small, small disadvantaged and women-owned small business concerns have an equitable opportunity to compete for subcontracts.

(9) Assurance that the offeror will include the clause in this contract entitled "Utilization of Small, Small Disadvantaged and Women-Owned Small Business Concerns" in all subcontracts that offer further subcontracting opportunities, and that the offeror will require all subcontractors (except small business concerns) who receive subcontracts in excess of \$500,000 (\$1,000,000 for construction of any public facility) to adopt a plan similar to the plan agreed to by the offeror.

(10) Assurances that the offeror will (i) cooperate in any studies or surveys as may be required, (ii) submit periodic reports in order to allow the Government to determine the extent of compliance by the offeror with the subcontracting plan, (iii) submit Standard Form (SF) 294, Subcontracting Report for Individual Contracts, and/or SF 295,

Summary Subcontract Report, in accordance with the instructions on the forms, and (iv) ensure that its subcontractors agree to submit Standard Forms 294 and 295.

(11) A recitation of the types of records the offeror will maintain to demonstrate procedures that have been adopted to comply with the requirements and goals in the plan, including establishing source lists; and a description of its efforts to locate small, small disadvantaged and women-owned small business concerns and award subcontracts to them. The records shall include at least the following (on a plant-wide or company-wide basis, unless otherwise indicated):

(i) Source lists (e.g., PASS), guides, and other data that identify small, small disadvantaged and women-owned small business concerns.

(ii) Organizations contacted in an attempt to locate sources that are small, small disadvantaged or women-owned small business concerns.

(iii) Records on each subcontract solicitation resulting in an award of more than \$100,000, indicating (A) whether small business concerns were solicited and if not, why not, (B) whether small disadvantaged business concerns were solicited and if not, why not, (C) whether women-owned small business concerns were solicited and if not, why not, and (D) if applicable, the reason award was not made to a small business concern.

(iv) Records of any outreach efforts to contact (A) trade associations, (B) business development organizations, and (C) conferences and trade fairs to locate small, small disadvantaged and women-owned small business sources.

(v) Records of internal guidance and encouragement provided to buyers through (A) workshops, seminars, training, etc., and (B) monitoring performance to evaluate compliance with the program's requirements.

(vi) On a contract-by-contract basis, records to support award data submitted by the offeror to the Government, including the name, address, and business size of each subcontractor. Contractors having company or division-wide annual plans need not comply with this requirement.

(e) In order to effectively implement this plan to the extent consistent with efficient contract performance, the Contractor shall perform the following functions:

(1) Assist small, small disadvantaged and women-owned small business concerns by arranging solicitations, time for the preparation of bids, quantities, specifications, and delivery schedules so as to facilitate the participation by such concerns. Where the contractor's lists of potential small, small disadvantaged and women-owned small business subcontractors are excessively long, reasonable effort shall be made to give all such small business concerns an opportunity to compete over a period of time.

(2) Provide adequate and timely consideration of the potentialities of small, small disadvantaged and women-owned small business concerns in all "make-or-buy" decisions.

(3) Counsel and discuss subcontracting opportunities with representative of small, small disadvantaged and women-owned small business firms.

(4) Provide notice to subcontractors concerning penalties and remedies for misrepresentations of business status as small, small disadvantaged or women-owned small business for the purpose of obtaining a subcontract that is to be included as part or all of a goal contained in the Contractor's subcontracting plan.

(f) A master subcontracting plan on a plant or division-wide basis which contains all the elements required by (d) above, except goals, may be incorporated by reference as a part of the subcontracting plan required of the offeror by this clause; provided, (1) the master plan has been approved, (2) the offeror ensures that the master plan is updated as necessary and provides copies of the approved master plan, including evidence of its approval, to the Contracting Officer, and (3) goals and any deviations from the master plan deemed necessary by the Contracting Officer to satisfy the requirements of this contract are set forth in the individual subcontracting plan.

(g)(1) If a commercial product is offered, the subcontracting plan required by this clause may relate to the offeror's production generally, for both commercial and non-commercial products, rather than solely to the Government contract. In these cases, the offeror shall, with the concurrence of the Contracting Officer, submit one company-wide or division-wide annual plan.

(2) The annual plan shall be reviewed for approval by the agency awarding the offeror its first prime contract requiring a subcontracting plan during the fiscal year, or by an agency satisfactory to the Contracting Officer.

(3) The approved plan shall remain in effect during the offeror's fiscal year for all of the offeror's commercial products.

(h) Prior compliance of the offeror with other such subcontracting plans under previous contracts will be considered by the Contracting Officer in determining the responsibility of the offeror for award of the contract.

(i) The failure of the Contractor or subcontractor to comply in good faith with (1) the clause of this contract entitled "Utilization of Small, Small Disadvantaged and Women-Owned Small Business Concerns," or (2) an approved plan required by this clause, shall be a material breach of the contract.

(End of clause)

**31. LIMITATIONS ON SUBCONTRACTING (DEC 1996) FAR 52.219-14**

*NOTE: This clause applies only if the contract, or any portion of the contract is set-aside for small business or set-aside for the 8(a) program.*

- (a) This clause does not apply to the unrestricted portion of a partial set-aside.
  - (b) By submission of an offer and execution of a contract, the Offeror/Contractor agrees that in performance of the contract in the case of a contract for--
    - (1) *Services (except construction)*. At least 50 percent of the cost of contract performance incurred for personnel shall be expended for employees of the concern.
    - (2) *Supplies (other than procurement from a nonmanufacturer of such supplies)*. The concern shall perform work for at least 50 percent of the cost of manufacturing the supplies, not including the cost of materials.
    - (3) *General construction*. The concern will perform at least 15 percent of the cost of the contract, not including the cost of materials, with its own employees.
    - (4) *Construction by special trade contractors*. The concern will perform at least 25 percent of the cost of the contract, not including the cost of materials, with its own employees.
- (End of clause)

**32. LIQUIDATED DAMAGES--SUBCONTRACTING PLAN (OCT 1995) FAR 52.219-16**

- (a) "Failure to make a good faith effort to comply with the subcontracting plan", as used in this clause, means a willful or intentional failure to perform in accordance with the requirements of the subcontracting plan approved under the clause in this contract entitled "Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan," or willful or intentional action to frustrate the plan.
  - (b) If, at contract completion, or in the case of a commercial product plan, at the close of the fiscal year for which the plan is applicable, the Contractor has failed to meet its subcontracting goals and the Contracting Officer decides in accordance with paragraph (c) of this clause that the Contractor failed to make a good faith effort to comply with its subcontracting plan, established in accordance with the clause in this contract entitled "Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan," the Contractor shall pay the Government liquidated damages in an amount stated. The amount of probable damages attributable to the Contractor's failure to comply, shall be an amount equal to the actual dollar amount by which the Contractor failed to achieve each subcontract goal or, in the case of a commercial products plan, that portion of the dollar amount allocable to Government contracts by which the Contractor failed to achieve each subcontract goal.
  - (c) Before the Contracting Officer makes a final decision that the Contractor has failed to make such good faith effort, the Contracting Officer shall give the Contractor written notice specifying the failure and permitting the Contractor to demonstrate what good faith efforts have been made. Failure to respond to the notice may be taken as an admission that no valid explanation exists. If, after consideration of all pertinent data, the Contracting Officer finds that the Contractor failed to make a good faith effort to comply with the subcontracting plan, the Contracting Officer shall issue a final decision to that effect and require that the Contractor pay the Government liquidated damages as provided in paragraph (b) of this clause.
  - (d) With respect to commercial product plans; i.e., company-wide or division-wide subcontracting plans approved under paragraph (g) of the clause in this contract entitled "Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan," the Contracting Officer of the agency that originally approved the plan will exercise the functions of the Contracting Officer under this clause on behalf of all agencies that awarded contracts covered by that commercial product plan.
  - (e) The Contractor shall have the right of appeal, under the clause in this contract entitled, Disputes, from any final decision of the Contracting Officer.
  - (f) Liquidated damages shall be in addition to any other remedies that the Government may have.
- (End of clause)

**33. SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS SUBCONTRACTING PLAN (DoD CONTRACTS) (APR 1996) DFARS 252.219-7003**

This clause supplements the Federal Acquisition Regulation 52.219-9, Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan, clause of this contract.

(a) *Definitions.*

“Historically black colleges and universities,” as used in this clause, means institutions determined by the Secretary of Education to meet the requirements of 34 CFR Section 608.2. The term also means any nonprofit research institution that was an integral part of such a college or university before November 14, 1986.

“Minority institutions,” as used in this clause, means institutions meeting the requirement of Section 1046(3) of the Higher Education Act of 1965 (20 U.S.C. 1135d-5(3)). The term also includes Hispanic-serving institutions as defined in Section 316(b)(1) of such Act (20 U.S.C. 1059c(b)(1)).

(b) Except for company or division-wide commercial items subcontracting plans, the term “small disadvantaged business,” when used in the FAR 52.219-9 clause, includes historically black colleges and universities and minority institutions, in addition to small disadvantaged business concerns.

(c) Work under the contract or its subcontracts shall be credited toward meeting the small disadvantaged business concern goal required by paragraph (d) of the FAR 52.219-9 clause when:

- (1) It is performed on Indian lands or in joint venture with an Indian tribe or a tribally-owned corporation, and
- (2) It meets the requirements of 10 U.S.C. 2323a.

(d) Subcontracts awarded to workshops approved by the Committee for Purchase from People Who are Blind or Severely Disabled (41 U.S.C. 46-48), may be counted toward the Contractor’s small business subcontracting goal.

(e) A mentor firm, under the Pilot Mentor-Protégé Program established under Section 831 of Pub. L. 101-510, as amended, may count toward its small disadvantaged business goal, subcontracts awarded--

- (1) Protégé firms which are qualified organizations employing the severely handicapped; and
- (2) Former protégé firms that meet the criteria in Section 831(g)(4) of Pub. L. 101-510.

(f) The master plan approval referred to in paragraph (f) of the FAR 52.219-9 clause is approval by the Contractor’s cognizant contract administration activity.

(g) In those subcontracting plans which specifically identify small, small disadvantaged, and women-owned small businesses, the Contractor shall notify the Administrative Contracting Officer of any substitutions of firms that are not small, small disadvantaged, or women-owned small businesses for the firms listed in the subcontracting plan. Notifications shall be in writing and shall occur within a reasonable period of time after award of the subcontract. Contractor-specified formats shall be acceptable.

(End of clause)

**34. NOTICE TO THE GOVERNMENT OF LABOR DISPUTES (FEB 1997) FAR 52.222-1**

If the Contractor has knowledge that any actual or potential labor dispute is delaying or threatens to delay the timely performance of this contract, the Contractor shall immediately give notice, including all relevant information, to the Contracting Officer.

(End of clause)

**35 CONVICT LABOR (AUG 1996) FAR 52.222-3**

The Contractor agrees not to employ in the performance of this contract any person undergoing a sentence of imprisonment which has been imposed by any court of a State, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, or the Trust Territory of the Pacific Islands. This limitation, however, shall not prohibit the employment by the Contractor in the performance of this contract of persons on parole or probation to work at paid employment during the term of their sentence or persons who have been pardoned or who have served their terms. Nor shall it prohibit the employment by the Contractor in the performance of this contract of persons confined for violation of the laws of any of the States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, or the Trust Territory of the Pacific Islands who are authorized to work at paid employment in the community under the laws of such jurisdiction, if--

- (a) (1) The worker is paid or is in an approved work training program on a voluntary basis;
- (2) Representatives of local union central bodies or similar labor union organizations have been consulted;
- (3) Such paid employment will not result in the displacement of employed workers, or be applied in skills, crafts, or trades in which there is a surplus of available gainful labor in the locality, or impair existing contracts for services;
- (4) The rates of pay and other conditions of employment will not be less than those paid or provided for work of a similar nature in the locality in which the work is being performed; and

(b) The Attorney General of the United States has certified that the work-release laws or regulations of the jurisdiction involved are in conformity with the requirements of Executive Order 11755, as amended by Executive Orders 12608 and 12943.

(End of clause)

**36. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT--OVERTIME  
COMPENSATION (JUL 1995) FAR 52.222-4**

(a) *Overtime requirements.* No Contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics (see Federal Acquisition Regulation (FAR) 22.300) shall require or permit any such laborers or mechanics in any workweek in which the individual is employed on such work to work in excess of 40 hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than 1-1/2 times the basic rate of pay for all hours worked in excess of 40 hours in such workweek.

(b) *Violation; liability for unpaid wages; liquidated damages.* In the event of any violation of the provisions set forth in paragraph (a) of this clause, the Contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such Contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanical employed in violation of the provisions set forth in paragraph (a) of this clause in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of 40 hours without payment of the overtime wages required by provisions set forth in paragraph (a) of this clause.

(c) *Withholding for unpaid wages and liquidated damages.* The Contracting Officer shall upon his or her own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the Contractor or subcontractor under any such contract or any other Federal contract with the same Prime Contractor, or any other Federally-assisted contract subject to the Contract Work Hours and Safety Standards Act which is held by the same Prime Contractor, such sums as may be determined to be necessary to satisfy any liabilities of such Contractor or subcontractor for unpaid wages and liquidated damages as provided in the provisions set forth in paragraph (b) of this clause.

(d) *Payrolls and basic records.* (1) The Contractor or subcontractor shall maintain payrolls and basic payroll records during the course of contract work and shall preserve them for a period of 3 years from the completion of the contract for all laborers and mechanics working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Nothing in this paragraph shall require the duplication of records required to be maintained for construction work by Department of Labor regulations at 29 CFR 5.5(a)(3) implementing the Davis-Bacon Act.

(2) The records to be maintained under paragraph (d)(1) of this clause shall be made available by the Contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the Contracting Officer or the Department of Labor. The Contractor or subcontractor shall permit such representatives to interview employees during working hours on the job.

(e) *Subcontracts.* The Contractor or subcontractor shall insert in any subcontracts exceeding \$100,000 the provisions set forth in paragraphs (a) through (e) of this clause and also a clause requiring the subcontractors to include these provisions in any lower tier subcontracts. The Prime Contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the provisions set forth in paragraphs (a) through (e) of this clause.

(End of clause)

**37. DAVIS-BACON ACT (FEB 1995) FAR 52.222-6**

(a) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR Part 3), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (d) of this clause; also, regular contributions made or costs incurred for more than a weekly



period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such period. Such laborers and mechanics shall be paid not less than the appropriate wage rate and fringe benefits in the wage determination for the classification of work actually performed, without regard to skill, except as provided in the clause entitled Apprentices and Trainees. Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein; provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classifications and wage rates conformed under paragraph (b) of this clause) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the Contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(b)(1) The Contracting Officer shall require that any class of laborers or mechanics which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The Contracting Officer shall approved an additional classification and wage rate and fringe benefits therefor only when all the following criteria have been met:

(i) The work to be performed by the classification requested is not performed by a classification in the wage determination.

(ii) The classification is utilized in the area by the construction industry.

(iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(2) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the Contracting Officer agree on the classification and wage rate (including the amount designated for fringe benefits, where appropriate), a report of the action taken shall be sent by the Contracting Officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator or an authorized representative will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the Contracting Officer or will notify the Contracting Officer within the 30-day period that additional time is necessary.

(3) In the event the Contractor, the laborers or mechanics to be employed in the classification, or their representatives, and the Contracting Officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the Contracting Officer shall refer the questions, including the views of all interested parties and the recommendation of the Contracting Officer, to the Administrator of the Wage and Hour Division for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the Contracting Officer or will notify the Contracting Officer within the 30-day period that additional time is necessary.

(4) The wage rate (including fringe benefits, where appropriate) determined pursuant to subparagraphs (b)(2) and (b)(3) of this clause shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(c) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the Contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(d) If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program; provided, That the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(End of clause)

### **38. WITHHOLDING OF FUNDS (FEB 1988) FAR 52.222-7**

The Contracting Officer shall, upon his or her own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the Contractor under this contract or any other Federal contract with the same Prime Contractor, or any other Federally assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same Prime Contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the Contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer

or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the Contracting Officer may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(End of clause)

### **39. PAYROLLS AND BASIC RECORDS (FEB 1988) FAR 52.222-8**

(a) Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the work and preserved for a period of 3 years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made, and actual wages paid. Whenever the Secretary of Labor has found, under paragraph (d) of the clause entitled Davis-Bacon Act, that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the Contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(b)(1) The Contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the Contracting Officer. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under paragraph (a) of this clause. This information may be submitted in any form desired. Optional Form WH-347 (Federal Stock Number 029-005-00014-1) is available for this purpose and may be purchased from the Superintendent of Documents. U.S. Government Printing Office, Washington, DC 20402. The Prime Contractor is responsible for the submission of copies of payrolls by all subcontractors.

(2) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the Contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify--

(i) That the payroll for the payroll period contains the information required to be maintained under paragraph (a) of this clause and that such information is correct and complete;

(ii) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in the Regulations, 29 CFR Part 3; and

(iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(3) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by subparagraph (b)(2) of this clause.

(4) The falsification of any of the certifications in this clause may subject the Contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 3729 of Title 31 of the United States Code.

(c) The Contractor or subcontractor shall make the records required under paragraph (a) of this clause available for inspection, copying, or transcription by the Contracting Officer or authorized representatives of the Contracting Officer or the Department of Labor. The Contractor or subcontractor shall permit the Contracting Officer or representatives of the Contracting Officer or the Department of Labor to interview employees during working hours on the job. If the Contractor or subcontractor fails to submit required records or to make them available, the Contracting Officer may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(End of clause)

### **40. APPRENTICES AND TRAINEES (FEB 1988) FAR 52.222-9**

(a) *Apprentices.* Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State Apprenticeship Agency recognized by the Bureau, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the Contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated in this paragraph, shall be paid not less than the applicable wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rates) specified in the Contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Bureau of Apprenticeship and Training, or a State Apprenticeship Agency recognized by the Bureau, withdraws approval of an apprenticeship program, the Contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(b) *Trainees.* Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed in the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate in the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate in the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate in the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(c) *Equal employment opportunity.* The utilization of apprentices, trainees, and journeymen under this clause shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

(End of clause)

#### **41. COMPLIANCE WITH COPELAND ACT REQUIREMENTS (FEB 1988) FAR 52.222-10**

The Contractor shall comply with the requirements of 29 CFR Part 3, which are hereby incorporated by reference in this contract.

(End of clause)

#### **42. SUBCONTRACTS (LABOR STANDARDS) (FEB 1988) FAR 52.222-11**

(a) The Contractor or subcontractor shall insert in any subcontracts the clauses entitled *Davis-Bacon Act, Contract Work Hours and Safety Standards Act--Overtime Compensation, Apprentices and Trainees, Payrolls and Basic Records, Compliance with Copeland Act Requirements, Withholding of Funds, Subcontracts (Labor Standards), Contract Termination--Debarment, Disputes Concerning Labor Standards, Compliance with Davis-Bacon and Related Act Regulations, and Certification of Eligibility*, and such other clauses as the Contracting Officer may, by appropriate instructions, require, and also a clause requiring subcontractors to include these clauses in any lower tier subcontracts. The Prime Contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with all the contract clauses cited in this paragraph.

(b)(1) Within 14 days after award of the contract, the Contractor shall delivery to the Contracting Officer a completed Statement and Acknowledgment Form (SF 1413) for each subcontract, including the subcontractor's signed and dated acknowledgment that the clauses set forth in paragraph (a) of this clause have been included in the subcontract.

(2) Within 14 days after the award of any subsequently awarded subcontract the Contractor shall delivery to the Contracting Officer an updated completed SF 1413 for such additional subcontract.

(End of clause)

#### **43. CONTRACT TERMINATION--DEBARMENT (FEB 1988) FAR 52.222-12**

A breach of the contract clauses entitled *Davis-Bacon Act, Contract Work Hours and Safety Standards Act--Overtime Compensation, Apprentices and Trainees, Payrolls and Basic Records, Compliance with Copeland Act Requirements, Subcontracts (Labor Standards), Compliance with Davis-Bacon and Related Act Regulations, or Certification of Eligibility*, may be grounds for termination of the contract, and for debarment as a Contractor and subcontractor as provided in 29 CFR 5.12.

(End of clause)

#### **44. COMPLIANCE WITH DAVIS-BACON AND RELATED ACT REGULATIONS (FEB 1988) FAR 52.222-13**

All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3, and 5 are hereby incorporated by reference in this contract.

(End of clause)

#### **45. DISPUTES CONCERNING LABOR STANDARDS (FEB 1988) FAR 52.222-14**

The United States Department of Labor has set forth in 29 CFR Parts 5, 6, and 7 procedures for resolving disputes concerning labor standards requirements. Such disputes shall be resolved in accordance with those procedures and not the Disputes clause of this contract. Disputes within the meaning of this clause include disputes between the Contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

(End of clause)

#### **46. CERTIFICATION OF ELIGIBILITY (FEB 1988) FAR 52.222-15**

(a) By entering into this contract, the Contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the Contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(b) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(c) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

(End of clause)

#### **47. EQUAL OPPORTUNITY (APR 1984) FAR 52.222-26**

(a) If, during any 12-month period (including the 12 months preceding the award of this contract), the Contractor has been or is awarded nonexempt Federal contracts and/or subcontracts that have an aggregate value in excess of \$10,000, the Contractor shall comply with subparagraphs (b)(1) through (11) below. Upon request, the Contractor all provide information necessary to determine the applicability of this clause.

(b) During performing this contract, the Contractor agrees as follows:

(1) The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.

(2) The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. This shall include, but not be limited to, (i) employment, (ii) upgrading, (iii) demotion, (iv) transfer, (v) recruitment or recruitment advertising, (vi) layoff or termination, (vii) rates of pay or other forms of compensation, and (viii) selection for training, including apprenticeship.

(3) The Contractor shall post in conspicuous places available to employees and applicants for employment the notices to be provided by the Contracting Officer that explain this clause.

(4) The Contractor shall, in all solicitations or advertisement for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

(5) The Contractor shall send, to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, the notice to be provided by the Contracting Officer advising the labor union or workers' representative of the Contractor's commitments under this clause, and post copies of the notice in conspicuous places available to employees and applicants for employment.

(6) The Contractor shall comply with Executive Order 11246, as amended, and the rules, regulations, and orders of the Secretary of Labor.

(7) The Contractor shall furnish to the contracting agency all information required by Executive Order 11246, as amended, and by the rules, regulations, and orders of the Secretary of labor. Standard Form 100 (EEO-1), or any successor form, is the prescribed form to be filed within 30 days following the award, unless filed within 12 months preceding the date of award.

(8) The Contractor shall permit access to its books, records, and accounts by the contracting agency or the Office of Federal Contract Compliance Programs (OFCCP) for the purposes of investigation to ascertain the Contractor's compliance with the applicable rules, regulations, and orders.

(9) If the OFCCP determines that the Contractor is not in compliance with this clause or any rule, regulation, or order of the Secretary of Labor, this contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further Government contracts, under the procedures authorized in Executive Order 11246, as amended. In addition, sanctions may be imposed and remedies invoked against the Contractor as provided in Executive Order 11246, as amended, the rules, regulations, and orders of the Secretary of Labor, or as otherwise provided by law.

(10) The Contractor shall include the terms and conditions of subparagraph (b)(1) through (11) of this clause in every subcontract or purchase order that is not exempted by the rules, regulations, or orders of the Secretary of Labor issued under Executive Order 11246, as amended, so that these terms and conditions will be binding upon each subcontract or vendor.

(11) The Contractor shall take such action with respect to any subcontract or purchase order as the contracting agency may direct as a means of enforcing these terms and conditions, including sanctions for noncompliance; provided, that if the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of any direction, the Contractor may request the United States to enter into the litigation to protect the interests of the United States.

(c) Notwithstanding any other clause in this contract, disputes relative to this clause will be governed by the procedures in 41 CFR 60-1.1.

(End of clause)

#### **48. AFFIRMATIVE ACTION COMPLIANCE REQUIREMENTS FOR CONSTRUCTION (APR 1984) FAR 52.222-27**

(a) *Definitions.*

"Covered area," as used in this clause, means the geographical area described in the solicitation for this contract.

"Director," as used in this clause, means Director, Office of Federal Contract Compliance Programs (OFCCP), United States Department of Labor, or any person to whom the Director delegates authority.

"Employer identification number," as used in this clause, means the Federal Social Security number used on the employer's quarterly federal tax return, U.S. Treasury Department Form 941.

"Minority," as used in this clause, means--

(1) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

(2) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and

(3) Black (all persons having origins in any of the black African racial groups not of Hispanic origin);

(4) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race);

(b) If the Contractor, or a subcontractor at any tier, subcontracts a portion of the work involving any construction trade, each such subcontract in excess of \$10,000 shall include this clause and the Notice containing the goals for minority and female participation stated in the solicitation for this contract.

(c) If the Contractor is participating in a Hometown Plan (41 CFR 60-4) approved by the U.S. Department of Labor in a covered area, either individually or through an association, its affirmative action obligations on all work in the plan area (including goals) shall comply with the plan for those trades that have unions participating in the plan. Contractors must be able to demonstrate participation in, and compliance with, the provisions of the plan. Each Contractor or subcontractor participating in an approved plan is also required to comply with its obligations under the Equal Opportunity clause, and to make a good faith effort to achieve each goal under the plan in each trade in which it has employees. The overall good-faith performance by other Contractors or subcontractors toward a goal in an approved plan does not excuse any Contractor's or subcontractor's failure to make good-faith efforts to achieve the plan's goals.

(d) The Contractor shall implement the affirmative action procedures in subparagraphs (g)(1) through (16) of this clause. The goals stated in the solicitation for this contract are expressed as percentages of the total hours of employment and training of minority and female utilization that the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for the geographical area where that work is actually performed. The Contractor is expected to make substantially uniform progress toward its goals in each craft.

(e) Neither the terms and conditions of any collective bargaining agreement, nor the failure by a union with which the Contractor has a collective bargaining agreement, to refer minorities or women shall excuse the Contractor's obligations under this clause, Executive Order 11246, as amended, or the regulations thereunder.

(f) In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

(g) The Contractor shall take affirmative action to ensure equal employment opportunity. The evaluation of the Contractor's compliance with this clause shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully and implement affirmative action steps at least as extensive as the following:

(1) Ensure a working environment free of harassment, intimidation, and coercion at all sites and in all facilities where the Contractor's employees are assigned to work. The Contractor, if possible, will assign two or more women to each construction project. The Contractor shall ensure that foremen, superintendents, and other onsite supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at these sites or facilities.

(2) Establish and maintain a current list of sources for minority and female recruitment. Provide written notification to minority and female recruitment sources and community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

(3) Establish and maintain a current file of the names, addresses, and telephone numbers of each minority and female off-the-street applicant, referrals of minorities or females from unions, recruitment sources, or community organizations and the action taken with respect to each individual. If an individual was sent to the union hiring hall for referral and not referred back to the Contractor by the union or, if referred back, not employed by the Contractor, this shall be documented in the file, along with whatever additional actions the Contractor may have taken.

(4) Immediately notify the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred back to the Contractor a minority or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

(5) Develop on-the-job training opportunities and/or participate in training programs for the area that expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the

Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under subparagraph (g)(2) above.

(6) Disseminate the Contractor's equal employment policy by--

(i) Providing notice of the policy to unions and to training, recruitment, and outreach programs, and requesting their cooperation in assisting the Contractor in meeting its contract obligations;

(ii) Including the policy in any policy manual and in collective bargaining agreements;

(iii) Publicizing the policy in the company newspaper, annual report, etc.;

(iv) Reviewing the policy with all management personnel and with all minority and female employees at least once a year; and

(v) Posting the policy on bulletin boards accessible to employees at each location where construction work is performed.

(7) Review, at least annually, the Contractor's equal employment policy and affirmative action obligations with all employees having responsibility for hiring, assignment, layoff, termination, or other employment decisions. Conduct review of this policy with all onsite supervisory personnel before initiating construction work at a job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

(8) Disseminate the Contractor's equal employment policy externally by including it in any advertising in the news media, specifically including minority and female news media. Provide written notification to, and discuss this policy with, other Contractors and subcontractors with which the Contractor does or anticipates doing business.

(9) Direct recruitment efforts, both oral and written, to minority, female, and community organizations, to schools with minority and female students, and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than 1 month before the date for acceptance of applications for apprenticeship or training by any recruitment source, send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

(10) Encourage present minority and female employees to recruit minority persons and women. Where reasonable, provide after-school, summer, and vacation employment to minority and female youth both on the site and in other areas of the Contractor's workforce.

(11) Validate all tests and other selection requirements where required under 41 CFR 60-3.

(12) Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities. Encourage these employees to seek or to prepare for through appropriate training, etc., opportunities for promotion.

(13) Ensure that seniority practices, job classifications, work assignments, and other personnel practices do not have a discriminatory effect by continually monitoring all personnel and employment-related activities to ensure that the Contractor's obligations under this contract are being carried out.

(14) Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between sexes.

(15) Maintain a record of solicitations for subcontracts for minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

(16) Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's equal employment policy and affirmative action obligations.

(h) The Contractor is encouraged to participate in voluntary associations that may assist in fulfilling one or more of the affirmative action obligations contained in subparagraphs (g)(1) through (16). The efforts of a contractor association, joint contractor-union, contractor-community, or similar group of which the contractor is a member and participate may be asserted as fulfilling one or more of its obligations under subparagraphs (g)(1) through (16), provided the Contractor--

(1) Actively participates in the group;

(2) Makes every effort to ensure that the group has a positive impact on the employment of minorities and women in the industry;

(3) Ensures that concrete benefits of the program are reflected in the Contractor's minority and female workforce participation;

(4) Make a good-faith effort to meet its individual goals and timetables; and

(5) Can provide access to documentation that demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply is the Contractor's, and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

(i) A single goal for minorities and a separate single goal for women shall be established. The Contractor is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and

all women, both minority and nonminority. Consequently, the Contractor may be in violation of Executive Order 11246, as amended, if a particular group is employed in a substantially disparate manner.

(j) The Contractor shall not use goals or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

(k) The Contractor shall not enter into any subcontract with any person or firm debarred from Government contracts under Executive Order 11246, as amended.

(l) The Contractor shall carry out such sanctions and penalties for violation of this clause and of the Equal Opportunity clause, including suspension, termination, and cancellation of existing subcontracts, as may be imposed or ordered under Executive Order 11246, as amended, and its implementing regulations, by the OFCCP. Any failure to carry out these sanctions and penalties as ordered shall be a violation of this clause and Executive Order 11246, as amended.

(m) The Contractor in fulfilling its obligations under this clause shall implement affirmative action procedures at least as extensive as those prescribed in paragraph (g) above, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of Executive Order 11246, as amended, the implementing regulations, or this clause, the Director shall take action as prescribed in 41 CFR 60-4.8.

(n) The Contractor shall designate a responsible official to--

(1) Monitor all employment-related activity to ensure that the Contractor's equal employment policy is being carried out;

(2) Submit reports as may be required by the Government; and

(3) Keep records that shall at least include for each employee the name, address, telephone number, construction trade, union affiliation (if any), employee identification number, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, separate records are not required to be maintained.

(o) Nothing contained herein shall be construed as a limitation upon the application of other laws that establish different standards of compliance or upon the requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

(End of clause)

#### **49. AFFIRMATIVE ACTION FOR DISABLED AND VIETNAM ERA VETERANS (APR 1998) FAR 52.222-35**

(a) *Definition.* As used in this clause--.

All employment openings includes all positions except executive and top management, those positions that will be filled from within the contractor's organization, and positions lasting 3 days or less. This term includes full-time employment, temporary employment of more than 3 days' duration, and part-time employment.

Appropriate office of the State employment service system, means the local office of the Federal-State national system of public employment offices with assigned responsibility to serve the area where the employment opening is to be filled including the District of Columbia, Guam, the Commonwealth of Puerto Rico, and the Virgin Islands.

Positions that will be filled from within the Contractor's organization means employment openings for which no consideration will be given to persons outside the Contractor's organization (including affiliates, subsidiaries, and parent companies) and includes any openings that the Contractor proposes to fill from regularly established "recall" lists. The exception does not apply to a particular opening once an employee decides to consider applicants outside of its organization.

Veteran of the Vietnam era means a person who--

(1) Served on active duty for a period of more than 180 days, any part of which occurred between August 5, 1964, and May 7, 1975, and was discharged or released therefrom with other than a dishonorable discharge; or

(2) Was discharged or released from active duty for a service-connected disability if any part of such active duty was performed between August 5, 1964, and May 7, 1975.

(b) *General.* (1) Regarding any position for which the employee or applicant for employment is qualified, the Contractor shall not discriminate against the individual because the individual is a disabled veteran or a veteran of the Vietnam era. The Contractor agrees to take affirmative action to employ, advance in employment, and otherwise treat qualified disabled veterans and veterans of the Vietnam era without discrimination based upon their disability or veterans' status in all employment practices such as--

(i) Employment;

(ii) Upgrading;



- (iii) Demotion or transfer;
- (iv) Recruitment;
- (v) Advertising;
- (vi) Layoff or termination;
- (vii) Rates of pay or other forms of compensation; and
- (viii) Selection for training, including apprenticeship.

(2) The Contractor agrees to comply with the rules, regulations, and relevant orders of the Secretary of Labor (Secretary) issued under the Vietnam Era Veterans' Readjustment Assistance Act of 1972 (the Act), as amended.

(c) *Listing openings.* (1) The Contractor agrees to list all employment openings existing at contract award or occurring during contract performance, at an appropriate office of the State employment service system in the locality where the opening occurs. These openings include those occurring at any Contractor facility, including one not connected with performing this contract. An independent corporate affiliate is exempt from this requirement.

(2) State and local government agencies holding Federal contracts of \$10,000 or more shall also list all employment openings with the appropriate office of the State employment service.

(3) The listing of employment openings with the State employment service system is required at least concurrently with using any other recruitment source or effort and involves the obligations of placing a bona fide job order, including accepting referrals of veterans and nonveterans. This listing does not require hiring any particular job applicant or hiring from any particular group of job applicants and is not intended to relieve the Contractor from any requirements of Executive orders or regulations concerning nondiscrimination in employment.

(4) Whenever the Contractor becomes contractually bound to the listing terms of this clause, it shall advise the State employment service system, in each State where it has establishments, of the name and location of each hiring location in the State. As long as the Contractor is contractually bound to these terms and has so advised the State system, it need not advise the State system of subsequent contracts. The Contractor may advise the State system when it is no longer bound by this contract clause.

(d) *Applicability.* This clause does not apply to the listing of employment openings which occur and are filled outside the 50 States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, and the Virgin Islands.

(e) *Postings.* (1) The Contractor agrees to post employment notices stating (i) the Contractor's obligation under the law to take affirmative action to employ and advance in employment qualified disabled veterans and veterans of the Vietnam era, and (ii) the rights of applicants and employees.

(2) These notices shall be posted in conspicuous places that are available to employees and applicants for employment. They shall be in a form prescribed by the Deputy Assistant Secretary for Federal Contract Compliance Programs, Department of Labor (Deputy Assistant Secretary), and provided by or through the Contracting Officer.

(3) The Contractor shall notify each labor union or representative of workers with which it has a collective bargaining agreement or other contract understanding, that the Contractor is bound by the terms of the Act, and is committed to take affirmative action to employ, and advance in employment, qualified disabled veterans and veterans of the Vietnam Era.

(f) *Noncompliance.* If the Contractor does not comply with the requirements of this clause, appropriate actions may be taken under the rules, regulations, and relevant orders of the Secretary issued pursuant to the Act.

(g) *Subcontracts.* The Contractor shall include the terms of this clause in every subcontract or purchase order of \$10,000 or more unless exempted by rules, regulations, or orders of the Secretary. The Contractor shall act as specified by the Deputy Assistant Secretary to enforce the terms, including action for noncompliance.

(End of clause)

## 50. AFFIRMATIVE ACTION FOR HANDICAPPED WORKERS (APR 1984) FAR 52.222-36

(a) *General.* (1) Regarding any position for which the employee or applicant for employment is qualified, the Contractor shall not discriminate against any employee or applicant because of physical or mental handicap. The Contractor agrees to take affirmative action to employ, advance in employment, and otherwise treat qualified handicapped individuals without discrimination based upon their physical or mental handicap in all employment practices such as--

- (i) Employment;
- (ii) Upgrading;
- (iii) Demotion or transfer;
- (iv) Recruitment;
- (v) Advertising;
- (vi) Layoff or termination;
- (vii) Rates of pay or other forms of compensation; and

(viii) Selection for training, including apprenticeship.

(2) The Contractor agrees to comply with the rules, regulations, and relevant orders of the Secretary of Labor (Secretary) issued under the Rehabilitation Act of 1973 (29 U.S.C. 793) (the Act), as amended.

(b) *Postings.* (1) The Contractor agrees to post employment notices stating (i) the Contractor's obligation under the law to take affirmative action to employ and advance in employment qualified handicapped individuals and (ii) the rights of applicants and employees.

(2) These notices shall be posted in conspicuous places that are available to employees and applicants for employment. They shall be in a form prescribed by the Director, Office of Federal Contract Compliance Programs, Department of Labor (Director), and provided by or through the Contracting Officer.

(3) The Contractor shall notify each labor union or representative of workers with which it has a collective bargaining agreement or other contract understanding, that the Contractor is bound by the terms of Section 503 of the Act and is committed to take affirmative action to employ, and advance in employment, qualified physically and mentally handicapped individuals.

(e) *Noncompliance.* If the Contractor does not comply with the requirements of this clause, appropriate actions may be taken under the rules, regulations, and relevant orders of the Secretary issued pursuant to the Act.

(d) *Subcontracts.* The Contractor shall include the terms of this clause in every subcontract or purchase order in excess of \$2,500 unless exempted by rules, regulations, or orders of the Secretary. The Contractor shall act as specified by the Director to enforce the terms, including action for noncompliance.

(End of clause)

**51. EMPLOYMENT REPORTS ON DISABLED VETERANS AND VETERANS OF THE VIETNAM ERA (APR 1998) FAR 52.222-37**

(a) Unless the Contractor is a State or local government agency, the contractor shall report at least annually, as required by the Secretary of Labor, on--

(1) The number of disabled veterans and the number of veterans of the Vietnam era in the workplace of the contractor by job category and hiring location; and

(2) The total number of new employees hired during the period covered by the report, and of that total, the number of disabled veterans, and the number of veterans of the Vietnam era.

(b) The above items shall be reported by completing the form entitled "Federal Contractor Veterans' Employment Report VETS-100."

(c) Reports shall be submitted no later than March 31 of each year beginning March 31, 1988.

(d) The employment activity report required by paragraph (a)(2) of this clause shall reflect total hires during the most recent 12-month period as of the ending data selected for the employment profile report required by paragraph (a)(1) of this clause. Contractors may select an ending date: (1) As of the end of any pay period during the period January through March 1 of the year the report is due, or (2) as of December 31, if the contractor has previous written approval from the Equal Employment Opportunity Commission to do so for purposes of submitting the Employer Information Report EEO-1 (Standard Form 100).

(e) The count of veterans reported according to paragraph (a) of this clause shall be based on voluntary disclosure. Each contractor subject to the reporting requirements at 38 U.S.C. 4212 shall invite all disabled veterans and veterans of the Vietnam era who wish to benefit under the affirmative action program at 38 U.S.C. 4212 to identify themselves to the contractor. The invitation shall state that the information is voluntarily provided; that the information will be kept confidential; that disclosure or refusal to provide the information will not subject the applicant or employee to any adverse treatment; and that the information will be used only in accordance with the regulations promulgated under 38 U.S.C. 4212.

(f) *Subcontracts.* The Contractor shall include the terms of this clause in every subcontract or purchase order of \$10,000 or more unless exempted by rules, regulations, or orders of the Secretary.

(End of clause)

**52. CLEAN AIR AND WATER (APR 1984) FAR 52.223-2**

(a) "Air Act," as used in this clause, means the Clean Air Act (42 U.S.C. 7401 et seq.).

"Clean air standards," as used in this clause, means--

(1) Any enforceable rules, regulations, guidelines, standards, limitations, orders, controls, prohibitions, work practices, or other requirements contained in, issued under, or otherwise adopted under the Air Act or Executive Order 11738;

- (2) An applicable implementation plan as described in section 110(d) of the Air Act (42 U.S.C. 7410(d));
- (3) An approved implementation procedure or plan under section 111(c) or section 111(d) of the Air Act (42 U.S.C. 7411(c) or (d)); or
- (4) An approved implementation procedure under section 112(d) of the Air Act (42 U.S.C. 7412(d)).

“Clean water standards,” as used in this clause, means any enforceable limitation, control, condition, prohibition, standard, or other requirement promulgated under the Water Act or contained in a permit issued to a discharger by the EPA or by a State under an approved program, as authorized by section 402 of the Water Act (33 U.S.C. 1342), or by local government to ensure compliance with pretreatment regulations as required by section 307 of the Water Act (33 U.S.C. 1317).

“Compliance,” as used in this clause, means compliance with--

- (1) Clean air or water standards; or
- (2) A schedule or plan ordered or approved by a court of competent jurisdiction, the EPA, or an air or water pollution control agency under the requirements of the Air Act or Water Act and related regulations.

“Facility,” as used in this clause, means any building, plant, installation, structure, mine, vessel or other floating craft, location, or site of operations, owned, leased, or supervised by a Contractor or subcontractor, used in the performance of a contract or subcontract. When a location or site of operations includes more than one building, plant, installation, or structure, the entire location or site shall be deemed a facility except when the Administrator, or a designee, of the EPA determines that independent facilities are collocated in one geographical area.

“Water Act,” as used in this clause, means Clean Water Act (33 U.S.C. 1251 et seq.).

(b) The Contractor agrees--

- (1) To comply with the requirements of section 114 of the Clean Air Act (42 U.S.C. 7414) and section 308 of the Clean Water Act (33 U.S.C. 1318) relating to inspection, monitoring, entry, reports, and information, as well as other requirements specified in section 114 and section 308 of the Air Act and the Water Act, and all regulations and guidelines issued to implement those acts before the award of this contract;
  - (2) That no portion of the work required by this prime contract will be performed in a facility listed on the EPA List of Violating Facilities on the date when this contract was awarded unless and until the EPA eliminates the name of the facility from the listing;
  - (3) To use best efforts to comply with clean air standards and clean water standards at the facility in which the contract is being performed; and
  - (4) To insert the substance of this clause into any nonexempt subcontract, including this subparagraph (b)(4).
- (End of clause)

### **53. POLLUTION PREVENTION AND RIGHT-TO-KNOW INFORMATION (APR 1998) FAR 52.223-5**

(a) Executive Order 12856 of August 3, 1993, requires Federal facilities to comply with the provisions of the Emergency Planning and Community Right-to-know Act of 1986 (EPCRA) (42 U.S.C. 11001-11050) and the Pollution Prevention Act of 1990 (PPA) (42 U.S.C. 13101-13109).

(b) The Contractor shall provide all information needed by the Federal facility to comply with the emergency planning reporting requirements of Section 302 of EPCRA; the emergency notice requirements of Section 304 of EPCRA; the list of Material Data Safety Sheets required by Section 311 of EPCRA; the emergency and hazardous chemical inventory forms of Section 312 of EPCRA; the toxic chemical release inventory of Section 313 of EPCRA, which includes the reduction and recycling information required by Section 6607 of PPA; and the toxic chemical reduction goals requirements of Section 3-302 of Executive Order 12856.

(End of clause)

### **54. DRUG-FREE WORKPLACE (JAN 1997) FAR 52.223-6**

(a) Definitions. As used in this clause--

“Controlled substance” means a controlled substance in schedules I through V of section 202 of the Controlled Substances Act (21 U.S.C. 812) and as further defined in regulation at 21 CFR 1308.11-1308.15.

“Conviction” means a finding of guilt (including a plea of nolo contendere) or imposition of sentence, or both, by any judicial body charged with the responsibility to determine violations of the Federal or State criminal drug statutes.

“Criminal drug statute” means a Federal or non-Federal criminal statute involving the manufacture, distribution, dispensing, possession or use of any controlled substance.

“Drug-free workplace” means the site(s) for the performance of work done by the Contractor in connection with a specific contract at which employees of the Contractor are prohibited from engaging in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance.

“Employee” means an employee of a Contractor directly engaged in the performance of work under a Government contract. “Directly engaged” is defined to include all direct cost employees and any other Contractor employee who has other than a minimal impact or involvement in contract performance.

“Individual” means an offeror/contractor that has no more than one employee including the offeror/contractor.

(b) The Contractor, if other than an individual, shall--within 30 days after award (unless a longer period is agreed to in writing for contracts of 30 days or more performance duration), or as soon as possible for contracts of less than 30 days performance duration--

(1) Publish a statement notifying its employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the Contractor’s workplace and specifying the actions that will be taken against employees for violations of such prohibition;

(2) Establish an ongoing drug-free awareness program to inform such employees about--

(i) The dangers of drug abuse in the workplace;

(ii) The Contractor’s policy of maintaining a drug-free workplace;

(iii) Any available drug counseling, rehabilitation, and employee assistance programs; and

(iv) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;.

(3) Provide all employees engaged in performance of the contract with a copy of the statement required by subparagraph (b)(1) of this clause;

(4) Notify such employees in writing in the statement required by subparagraph (b)(1) of this clause that, as a condition of continued employment on this contract, the employee will--

(i) Abide by the terms of the statement; and

(ii) Notify the employer in writing of the employee’s conviction under a criminal drug statute for a violation occurring in the workplace no later than 5 days after such conviction.

(5) Notify the Contracting Officer in writing within 10 days after receiving notice under subdivision (b)(4)(ii) of this clause, from an employee or otherwise receiving actual notice of such conviction. The notice shall include the position title of the employee;

(6) Within 30 days after receiving notice under subdivision (b)(4)(ii) of this clause of a conviction, take one of the following actions with respect to any employee who is convicted of a drug abuse violation occurring in the workplace:

(i) Taking appropriate personnel action against such employee, up to and including termination; or

(ii) Require such employee to satisfactorily participate in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency; and

(7) Make a good faith effort to maintain a drug-free workplace through implementation of subparagraphs (b)(1) through (b)(6) of this clause.

(c) The Contractor, if an individual, agrees by award of the contract or acceptance of a purchase order, not to engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance while performing this contract.

(d) In addition to other remedies available to the Government, the Contractor’s failure to comply with the requirements of paragraph (b) or (c) of this clause may, pursuant to FAR 23.506, render the Contractor subject to suspension of contract payments, termination of the contract for default, and suspension or debarment.

(End of clause)

## **55. OZONE-DEPLETING SUBSTANCES (JUN 1996) FAR 52.223-11**

(a) *Definition.* “Ozone-depleting substance”, as used in this clause, means any substance designated as Class I by the Environmental Protection Agency (EPA) (40 CFR Part 82), including but not limited to chlorofluorocarbons, halons, carbon tetrachloride, and methyl chloroform; or any substance designated as Class II by EPA (40 CFR Part 82), including but not limited to hydrochlorofluorocarbons.

(b) The Contractor shall label products which contain or are manufactured with ozone-depleting substances in the manner and to the extent required by 42 U.S.C. 7671j (b), (c), and (d) and 40 CFR Part 82, Subpart E, as follows:

“WARNING: Contains (or manufactured with, if applicable) \_\_\_\_\_\*, a substance(s) which harm(s) public health and environment by destroying ozone in the upper atmosphere.”

\*The Contractor shall insert the name of the substance(s).  
(End of clause)

**56. TOXIC CHEMICAL RELEASE REPORTING (OCT 1996) FAR 52.223-14**

(a) Unless otherwise exempt, the Contractor, as owner or operator of a facility used in the performance of this contract, shall file by July 1 for the prior calendar year an annual Toxic Chemical Release Form (Form R) as described in sections 313(a) and (g) of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) (42 U.S.C. 11023(a) and (g)), and section 6607 of the Pollution Prevention Act of 1990 (PPA) (42 U.S.C. 13106). The Contractor shall file, for each facility subject to the Form R filing and reporting requirements, the annual Form R throughout the life of the contract.

(b) A Contractor owned or operated facility used in the performance of this contract is exempt from the requirement to file an annual Form R if--

(1) The facility does not manufacture, process or otherwise use any toxic chemicals listed under section 313(c) of EPCRA, 42 U.S.C. 11023(c);

(2) The facility does not have 10 or more full-time employees as specified in section 313(b)(1)(A) of EPCRA, 42 U.S.C. 11023 (b)(1)(A);

(3) The facility does not meet the reporting thresholds of toxic chemicals established under section 313(f) of EPCRA, 42 U.S.C. 11023(f) (including the alternate thresholds at 40 CFR 372.27, provided an appropriate certification form has been filed with EPA);

(4) The facility does not fall within the Standard Industrial Classification Code (SIC) designations 20 through 39 as set forth in section 19.102 of the Federal Acquisition Regulation (FAR); or

(5) The facility is not located within any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Northern Mariana Islands, or any other territory or possession over which the United States has jurisdiction.

(c) If the Contractor has certified to an exemption in accordance with one or more of the criteria in paragraph (b) of this clause, and after award of the contract circumstances change so that any one of its owned or operated facilities used in the performance of this contract is no longer exempt--

(1) The Contractor shall notify the Contracting Officer; and

(2) The Contractor as owner or operator of a facility used in the performance of this contract that is no longer exempt, shall (i) submit a Toxic Chemical Release Inventory Form (Form R) on or before July 1 for the prior calendar year during which the facility becomes eligible; and (ii) continue to file the annual Form R for the life of the contract for such facility.

(d) The Contracting Officer may terminate this contract or take other action as appropriate, if the Contractor fails to comply accurately and fully with the EPCRA and PPA toxic chemical release filing and reporting requirements.

(e) Except for acquisitions of commercial items as defined in FAR Part 2, the Contractor shall--

(1) For competitive subcontracts expected to exceed \$100,000 (including all options), include a solicitation provision substantially the same as the provision at FAR 52.223-13, Certification of Toxic Chemical Release Reporting; and

(2) Include in any resultant subcontract exceeding \$100,000 (including all options), the substance of this clause, except this paragraph (e).

(End of clause)

**57. BUY AMERICAN ACT--CONSTRUCTION MATERIALS (JUN 1997) FAR 52.225-5**

*NOTE: This clause applies only to contracts less than \$6,500,000.*

(a) *Definitions.* As used in this clause--

The Buy American Act (41 U.S.C. 10) provides that the Government give preference to domestic construction material.

“Components” means those articles, materials, and supplies incorporated directly into construction materials.

“Construction material” means an article, material, or supply brought to the construction site for incorporation into the building or work. Construction material also includes an item brought to the site pre-assembled from articles, materials or supplies. However, emergency life safety systems, such as emergency lighting, fire alarm, and audio evacuation systems, which are discrete systems incorporated into a public building or work and which are produced as a

complete system, shall be evaluated as a single and distinct construction material regardless of when or how the individual parts or components of such systems are delivered to the construction site.

“Domestic construction material” means (1) an unmanufactured construction material mined or produced in the United States, or (2) a construction material manufactured in the United States, if the cost of its components mined, produced, or manufactured in the United States exceeds 50 percent of the cost of all its components. Components of foreign origin of the same class or kind as the construction materials determined to be unavailable pursuant to subparagraph 25.202(a)(2) of the Federal Acquisition Regulation (FAR) shall be treated as domestic.

(b) (1) The Buy American Act (41 U.S.C. 10a-10d) requires that only domestic construction material be used in performing this contract, except as provided in paragraphs (b)(2) and (b)(3) of this clause.

(2) This requirement does not apply to the excepted construction material or components listed by the Government as follows: (List will appear in Section H if required. )

(3) Other foreign construction material may be added to the list in paragraph (b)(2) of this clause if the Government determines that--

(i) The cost would be unreasonable (the cost of a particular domestic construction material shall be determined to be unreasonable when the cost of such material exceeds the cost of foreign material by more than 6 percent, unless the agency head determines a higher percentage to be appropriate);

(ii) The application of the restriction of the Buy American Act to a particular construction material would be impracticable or inconsistent with the public interest; or

(iii) The construction material is not mined, produced, or manufactured in the United States in sufficient and reasonably available commercial quantities of a satisfactory quality.

(4) The Contractor agrees that only domestic construction material will be used by the Contractor, subcontractors, material men, and suppliers in the performance of this contract, except for foreign construction materials, if any, listed in paragraph (b)(2) of this clause.

(c) *Request for determination.* (1) Contractors requesting to use foreign construction material under paragraph (b)(3) of this clause shall provide adequate information for Government evaluation of the request for a determination regarding the inapplicability of the Buy American Act. Each submission shall include a description of the foreign and domestic construction materials, including unit of measure, quantity, price, time of delivery or availability, location of the construction project, name and address of the proposed contractor, and a detailed justification of the reason for use of foreign materials cited in accordance with paragraph (b)(3) of this clause. A submission based on unreasonable cost shall include a reasonable survey of the market and a completed price comparison table in the format in paragraph (d) of this clause. The price of construction material shall include all delivery costs to the construction site and any applicable duty (whether or not a duty-free certificate may be issued).

(2) If the Government determines after contract award that an exception to the Buy American Act applies, the contract shall be modified to allow use of the foreign construction material, and adequate consideration shall be negotiated.

However, when the basis for the exception is the unreasonable price of a domestic construction material, adequate consideration shall not be less than the differential established in paragraph (b)(3)(i) of this clause.

(3) If the Government does not determine that an exception of the Buy American Act applies, the use of that particular foreign construction material will be a failure to comply with the Act.

(d) For evaluation of requests under paragraph (c) of this clause based on unreasonable cost, the following information any applicable supporting data based on the survey of suppliers shall be included in the request:

## FOREIGN AND DOMESTIC CONSTRUCTION MATERIALS PRICE COMPARISON

Construction material description	Unit of measure	Quantity	(dollars) *	Price
Item 1:				
Foreign construction material				
Domestic construction material				
Item 2:				
Foreign construction material				
Domestic construction material				
List name, address, telephone number, and contract for suppliers surveyed. Attach copy of response; if oral, attach summary. Include other applicable supporting information.				

\*Include all delivery costs to the construction site and any applicable duty (whether or not a duty-free entry certificate is issued).

This clause applies to the construction work performed under the contract.  
(End of clause)

### **58. RESTRICTIONS ON CERTAIN FOREIGN PURCHASES (OCT 1996) FAR 52.225-11**

- (a) Unless advance written approval of the Contracting Officer is obtained, the Contractor shall not acquire for use in the performance of this contract, any supplies or services originating from sources within, or that were located in or transported from or through, countries whose products are banned from importation into the United States under regulations of the Office of Foreign Assets Control, Department of the Treasury. Those countries include Cuba, Iran, Iraq, Libya, and North Korea.
- (b) The Contractor shall not acquire for use in the performance of this contract any supplies or services from entities controlled by the Government of Iraq.
- (c) The Contractor agrees to insert the provisions of this clause, including this paragraph (c), in all subcontracts hereunder.

(End of clause)

### **59. BUY AMERICAN ACT--CONSTRUCTION MATERIALS UNDER TRADE AGREEMENTS ACT AND NORTH AMERICAN FREE TRADE AGREEMENT (JUN 1997) FAR 52.225-15**

*NOTE: This clause applies only to acquisitions with an acquisition value of \$7,311,000 or more.*

(a) *Definitions.* As used in the clause--

“Components” means those articles, materials, and supplies incorporate directly into construction materials.

“Construction material” means an article, material, or supply brought to the construction site for incorporation into the building or work. Construction material also includes an item brought to the site pre-assembled from articles, materials, or supplies. However, emergency life safety systems, such as emergency lighting, fire alarm, and audio evacuation systems, which are discrete systems incorporated into a public building or work and which are produced as a complete system, shall be evaluated as a single and distinct construction material regardless of when or how the individual parts or components of such systems are delivered to the construction site.

“Designated country construction material” means a construction material that (a) is wholly the growth, product, or manufacture of a designated country (as defined at FAR 25.401), or (b) in the case of a construction material which consists in whole or in part of materials from another country or instrumentality, has been substantially transformed in a designated country into a new and different construction material distinct from the materials from which it was transformed.

“Domestic construction material” means (1) an unmanufactured construction material mined or produced in the United States, or (2) a construction material manufactured in the U.S., if the cost of its components mined, produced, or manufactured in the United States exceeds 50 percent of the cost of all its components. Components of foreign origin of

the same class or kind as the construction materials determined to be unavailable pursuant to subparagraph 25.202(a)(2) of the Federal Acquisition Regulation (FAR) shall be treated as domestic.

“North American Free Trade Agreement (NAFTA) country” means Canada or Mexico.

“NAFTA country construction material” means a construction material that (a) is wholly the growth, product, or manufacture of a NAFTA country, or (b) in the case of a construction material which consists in whole or in part of materials from another country or instrumentality, has been substantially transformed in a NAFTA country into a new and different construction material distinct from the materials from which it was transformed.

(b) (1) The Buy American Act (41 U.S.C. 10a-10d) requires that only domestic construction material be used in performing this contract, except as provided in paragraphs (b)(2), (b)(3), and (b)(4) of this clause.

(2) The Trade Agreements Act and the North American Free Trade Agreement (NAFTA) provide that designated country and NAFTA country construction materials are exempted from application of the Buy American Act.

(3) The requirement in paragraph (b)(1) of this clause does not apply to the excepted construction material or components listed by the Government as follows:  
(See Section 00800)

(4) Other foreign construction material may be added to the list in paragraph (b)(3) of this clause if the Government determines that--

(i) The cost would be unreasonable (the cost of a particular domestic construction material shall be determined to be unreasonable when the cost of such material exceeds the cost of foreign material exceeds the cost of foreign material by more than 6 percent, unless the agency head determines a higher percentage to be appropriate);

(ii) The application of the restriction of the Buy American Act to a particular construction material would be impracticable or inconsistent with the public interest; or

(iii) The construction material is not mined, produced, or manufactured in the United States in sufficient and reasonably available commercial quantities of a satisfactory quality.

(5) The Contractor agrees that only domestic construction materials, NAFTA country construction materials, or designated country construction materials will be used by the Contractor, subcontractors, material men, and suppliers in the performance of this contract, except for foreign construction materials if any, listed in paragraph (b)(3) of this clause.

(c) *Request for determination.* (1) Contractors requesting to use foreign construction material under paragraph (b)(4) of this clause shall provide adequate information for Government evaluation of the request for a determination regarding the inapplicability of the Buy American Act. Each submission shall include a description of the foreign and domestic construction materials, including unit of measure, quantity, price, time of delivery or availability, location of the construction project, name and address of the proposed contractor, and a detailed justification of the reason for use of foreign materials cited in accordance with paragraph (b)(4) of this clause. A submission based on unreasonable cost shall include a reasonable survey of the market and a completed price comparison table in the format in paragraph (d) of this clause. The price of construction materials shall include all delivery costs to the construction site and any applicable duty (whether or not a duty-free certificate may be issued).

(2) If the Government determines after contract award that an exception to the Buy American Act applies, the contract shall be modified to allow use of the foreign construction material, and adequate consideration all be negotiated. However, when the basis for the exception is the unreasonable price of a domestic construction material, adequate consideration all not be less than the differential established in paragraph (b)(4)(i) of this clause.

(3) If the Government does not determine that an exception to the Buy American Act applies, the use of that particular foreign construction material will be a failure to comply with the Act.

(d) For evaluation of requests under paragraph (c) of this clause based on unreasonable cost, the following information and any applicable supporting data based on the survey of suppliers shall be included in the request:

#### FOREIGN AND DOMESTIC CONSTRUCTION MATERIALS PRICE COMPARISON

Construction material description	Unit of measure	Quantity	Price (dollars) *
Item 1:			
Foreign construction material			
Domestic construction material			
Item 2:			
Foreign construction material			
Domestic construction material			



List name, address, telephone number, and contract for suppliers surveyed. Attach copy of response; if oral, attach summary. Include other applicable supporting information.

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\*Include all delivery costs to the construction site and any applicable duty (whether or not a duty-free certificate is issued).

(End of clause)

**60. BUY AMERICAN ACT--CONSTRUCTION MATERIALS UNDER TRADE AGREEMENTS ACT AND NORTH AMERICAN FREE TRADE AGREEMENT (MAY 1997) ALTERNATE I (MAY 1997) FAR 52.225-15 I**

*NOTE: This clause applies only to acquisitions with an acquisition value from \$6,500,000 to \$7,311,000.*

(a) *Definitions.* As used in the clause--

“Components” means those articles, materials, and supplies incorporate directly into construction materials.

“Construction material” means an article, material, or supply brought to the construction site for incorporation into the building or work. Construction material also includes an item brought to the site pre-assembled from articles, materials, or supplies. However, emergency life safety systems, such as emergency lighting, fire alarm, and audio evacuation systems, which are discrete systems incorporated into a public building or work and which are produced as a complete system, shall be evaluated as a single and distinct construction material regardless of when or how the individual parts or components of such systems are delivered to the construction site.

“Designated country construction material” means a construction material that (a) is wholly the growth, product, or manufacture of a designated country (as defined at FAR 25.401), or (b) in the case of a construction material which consists in whole or in part of materials from another country or instrumentality, has been substantially transformed in a designated country into a new and different construction material distinct from the materials from which it was transformed.

“Domestic construction material” means (1) an unmanufactured construction material mined or produced in the United States, or (2) a construction material manufactured in the U.S., if the cost of its components mined, produced, or manufactured in the United States exceeds 50 percent of the cost of all its components. Components of foreign origin of the same class or kind as the construction materials determined to be unavailable pursuant to subparagraph 25.202(a)(2) of the Federal Acquisition Regulation (FAR) shall be treated as domestic.

“North American Free Trade Agreement (NAFTA) country” means Canada or Mexico.

“NAFTA country construction material” means a construction material that (a) is wholly the growth, product, or manufacture of a NAFTA country, or (b) in the case of a construction material which consists in whole or in part of materials from another country or instrumentality, has been substantially transformed in a NAFTA country into a new and different construction material distinct from the materials from which it was transformed.

(b) (1) The Buy American Act (41 U.S.C. 10a-10d) requires that only domestic construction material be used in performing this contract, except as provided in paragraphs (b)(2), (b)(3), and (b)(4) of this clause.

(2) The North American Free Trade Agreement (NAFTA) provides that NAFTA construction materials are exempted from application of the Buy American Act.

(3) The requirement in paragraph (b)(1) of this clause does not apply to the excepted construction material or components listed by the Government as follows:  
(See Section H)

(4) Other foreign construction material may be added to the list in paragraph (b)(3) of this clause if the Government determines that--

(i) The cost would be unreasonable (the cost of a particular domestic construction material shall be determined to be unreasonable when the cost of such material exceeds the cost of foreign material exceeds the cost of foreign material by more than 6 percent, unless the agency head determines a higher percentage to be appropriate);

(ii) The application of the restriction of the Buy American Act to a particular construction material would be impracticable or inconsistent with the public interest; or

(iii) The construction material is not mined, produced, or manufactured in the United States in sufficient and reasonably available commercial quantities of a satisfactory quality.

(5) The Contractor agrees that only domestic construction materials, or NAFTA country construction materials, will be used by the Contractor, subcontractors, material men, and suppliers in the performance of this contract, except for foreign construction materials, if any, listed in paragraph (b)(3) of this clause.

(c) *Request for determination.* (1) Contractors requesting to use foreign construction material under paragraph (b)(4) of this clause shall provide adequate information for Government evaluation of the request for a determination regarding the inapplicability of the Buy American Act. Each submission shall include a description of the foreign and domestic construction materials, including unit of measure, quantity, price, time of delivery or availability, location of the construction project, name and address of the proposed contractor, and a detailed justification of the reason for use of foreign materials cited in accordance with paragraph (b)(4) of this clause. A submission based on unreasonable cost shall include a reasonable survey of the market and a completed price comparison table in the format in paragraph (d) of this clause. The price of construction materials shall include all delivery costs to the construction site and any applicable duty (whether or not a duty-free certificate may be issued).

(2) If the Government determines after contract award that an exception to the Buy American Act applies, the contract shall be modified to allow use of the foreign construction material, and adequate consideration all be negotiated. However, when the basis for the exception is the unreasonable price of a domestic construction material, adequate consideration all not be less than the differential established in paragraph (b)(4)(i) of this clause.

(3) If the Government does not determine that an exception to the Buy American Act applies, the use of that particular foreign construction material will be a failure to comply with the Act.

(d) For evaluation of requests under paragraph (c) of this clause based on unreasonable cost, the following information and any applicable supporting data based on the survey of suppliers shall be included in the request:

#### FOREIGN AND DOMESTIC CONSTRUCTION MATERIALS PRICE COMPARISON

Construction material description	Unit of measure	Quantity	(dollars) *	Price
Item 1:				
Foreign construction material				
Domestic construction material				
Item 2:				
Foreign construction material				
Domestic construction material				

List name, address, telephone number, and contract for suppliers surveyed. Attach copy of response; if oral, attach summary. Include other applicable supporting information.

\*Include all delivery costs to the construction site and any applicable duty (whether or not a duty-free certificate is issued).  
(End of clause)

#### **61. SECONDARY ARAB BOYCOTT OF ISRAEL (JUN 1992) DFARS 252.225-7031**

(a) *Definitions.* As used in this clause--

(1) "Foreign person" means any person other than a United States person as defined in Section 16(2) of the Export Administration Act of 1979 (50 U.S.C. App. Sec 2415).

(2) "United States person" is defined in Section 16(2) of the Export Administration Act of 1979 and means any United States resident or national (other than an individual resident outside the United States and employed by other than a United States person), any domestic concern (including any permanent domestic establishment of any foreign concern), and any foreign subsidiary or affiliate (including any permanent foreign establishment) of any domestic concern which is controlled in fact by such domestic concern, as determined under regulations of the President.

(b) *Certification.* By submitting this offer, the Offeror, if a foreign person, company or entity, certifies that it--

(1) Does not comply with the Secondary Arab Boycott of Israel; and

(2) Is not taking or knowingly agreeing to take any action, with respect to the Secondary Boycott of Israel of Arab countries, which 50 U.S.C. App. Sec. 2407(a) prohibits a United States person from taking.

(End of clause)

#### **62. UTILIZATION OF INDIAN ORGANIZATIONS AND INDIAN-OWNED ECONOMIC ENTERPRISES (SEP 1996) FAR 52.226-1**

(a) For Department of Defense contracts, this clause applies only if the contract includes a subcontracting plan incorporated under the terms of the clause at FAR 52.219-9, Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan. It does not apply to contracts awarded based on a subcontracting plan submitted and approved under paragraph (g) of the clause at 52.219-9.

(b) *Definitions.* As used in this clause:

“Indian” means any person who is a member of any Indian tribe, band, group, pueblo, or community which is recognized by the Federal Government as eligible for services from the Bureau of Indian Affairs (BIA) in accordance with 25 U.S.C. 1452(c) and any “Native” as defined in the Alaska Native Claims Settlement Act (43 U.S.C. 1601).

“Indian-organization” means the governing body of any Indian tribe or entity established or recognized by the governing body of an Indian tribe for the purposes of 25 U.S.C., chapter 17.

“Indian-owned economic enterprise” means any Indian-owned (as determined by the Secretary of the Interior) commercial, industrial, or business activity established or organized for the purpose of profit, provided that Indian ownership shall constitute not less than 51 percent of the enterprise.

“Indian tribe” means any Indian tribe, band, group, pueblo, or community, including native villages and native groups (including corporations organized by Kenai, Juneau, Sitka, and Kodiak) as defined in the Alaska Native Claims Settlement Act, which is recognized by the Federal Government as eligible for services from BIA in accordance with 25 U.S.C. 1452(c).

“Interested party” means a prime contractor or an actual or prospective offeror whose direct economic interest would be affected by the award of a subcontract or by the failure to award a subcontract.

(c) The Contractor agrees to use its best efforts to give Indian organizations and Indian-owned economic enterprises (25 U.S.C. 1544) the maximum practicable opportunity to participate in the subcontracts it awards to the fullest extent consistent with efficient performance of its contract.

(1) The Contracting Officer and the Contractor, acting in good faith, may rely on the self-certification of an Indian organization or Indian-owned economic enterprise as to its eligibility, unless an interested party challenges its status or the Contracting Officer has independent reason to question that status. In the event of a challenge to the self-certification of a subcontractor, the Contracting Officer shall refer the matter to the U.S. Department of the Interior, Bureau of Indian Affairs (BIA), Attn: Chief, Division of Contracting and Grants Administration, 1849 C Street, NW, MS-334A-SIB, Washington, DC 20245. The BIA will determine the eligibility and notify the Contracting Officer. The 5 percent incentive payment will not be made within 50 working days of subcontract award or while a challenge is pending. If a subcontractor is determined to be an ineligible participant, no incentive payment will be made under the Indian Incentive Program.

(2) The Contractor may request an adjustment under the Indian Incentive Program to the following:

- (i) The estimated cost of a cost-type contract;
- (ii) The target cost of a cost-plus-incentive-fee prime contract;
- (iii) The target cost and ceiling price of a fixed price incentive prime contract.
- (iv) The price of a firm-fixed-price prime contract.

(3) The amount of the equitable adjustment to the prime contract shall be 5 percent of the estimated cost, target cost, or firm-fixed-price included in the subcontract initially awarded to the Indian organization or Indian-owned economic enterprise.

(4) The Contractor has the burden of proving the amount claimed and must assert its request for an adjustment prior to completion of contract performance.

(d) The Contracting Officer, subject to the terms and conditions of the contract and the availability of funds, shall authorize an incentive payment of 5 percent of the amount paid to the subcontractor. The Contracting Officer shall seek funding in accordance with agency procedures. The Contracting Officer’s decision is final and not subject to the Dispute clause of this contract.

(End of clause)

### **63. AUTHORIZATION AND CONSENT (JUL 1995) FAR 52.227-1**

(a) The Government authorizes and consents to all use and manufacture, in performing any contract or any subcontract at any tier, of any invention described in and covered by a United States patent (1) embodied in the structure or composition of any article the delivery of which is accepted by the Government under this contract or (2) used in machinery, tools, or methods whose use necessarily results from compliance by the Contractor or a subcontractor with (i) specifications or written provisions forming a part of this contract or (ii) specific written instructions given by the Contracting Officer directing the manner of performance. The entire liability to the Government for infringement of a patent of the United States shall be determined solely by the provisions of the indemnity clause, if any, included in this

contract or any subcontract hereunder (including any lower-tier subcontract), and the Government assumes liability for all other infringement to the extent of the authorization and consent hereinabove granted.

(b) The Contractor agrees to include, and require inclusion of, this clause, suitably modified to identify the parties, in all subcontracts at any tier for supplies or services (including construction, architect-engineer services, and materials, supplies, models, samples, and design or testing services expected to exceed the simplified acquisition threshold); however, omission of this clause from any subcontract, including those at or below the simplified acquisition threshold, does not affect this authorization and consent.

(End of clause)

**64. PATENT INDEMNITY--CONSTRUCTION CONTRACTS (APR 1984) FAR 52.227-4**

Except as otherwise provided, the Contractor agrees to indemnify the Government and its officers, agents, and employees against liability, including costs and expenses, for infringement upon any United States patent (except a patent issued upon an application that is now or may hereafter be withheld from issue pursuant to a Secrecy Order under 35 U.S.C. 181) arising out of performing this contract or out of the use or disposal by or for the account of the Government of supplies furnished or work performed under this contract.

(End of clause)

**65. RIGHTS IN SHOP DRAWINGS (APR 1966) DFARS 252.227-7033**

(a) Shop drawings for construction means drawings, submitted to the Government by the Construction Contractor, subcontractor or any lower-tier subcontractor pursuant to a construction contract, showing in detail (i) the proposed fabrication and assembly of structural elements and (ii) the installation (i.e., form, fit, and attachment details) of materials or equipment. The Government may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.

(b) This clause, including this paragraph (b), shall be included in all subcontracts hereunder at any tier.

(End of clause)

**66. ADDITIONAL BOND SECURITY (OCT 1997) FAR 52.228-2**

The Contractor shall promptly furnish additional security required to protect the Government and persons supplying labor or materials under this contract if--

(a) Any surety upon any bond, or issuing financial institution for other security, furnished with this contract becomes unacceptable to the Government;

(b) Any surety fails to furnish reports on its financial condition as required by the Government;

(c) The contract price is increased so that the penal sum of any bond becomes inadequate in the opinion of the Contracting Officer; or

(d) An irrevocable letter of credit (ILC) used as security will expire before the end of the period of required security. If the Contractor does not furnish an acceptable extension or replacement ILC, or other acceptable substitute, at least 30 days before an ILC's scheduled expiration, the Contracting Officer has the right to immediately draw on the ILC.

(End of clause)

**67. INSURANCE--WORK ON A GOVERNMENT INSTALLATION (JAN 1997)  
FAR 52.228-5**

(a) The Contractor shall, at its own expense, provide and maintain during the entire performance of this contract, at least the kinds and minimum amounts of insurance required in the Schedule or elsewhere in the contract.

(b) Before commencing work under this contract, the Contractor shall notify the Contracting Officer in writing that the required insurance has been obtained. The policies evidencing required insurance shall contain an endorsement to the effect that any cancellation or any material change adversely affecting the Government's interest shall not be effective (1) for such period as the laws of the State in which this contract is to be performed prescribed or (2) until 30 days after the insurer or the Contractor gives written notice to the Contracting Officer, whichever period is longer.

(c) The Contractor shall insert the substance of this clause, including this paragraph (c), in subcontracts under this contract that require work on a Government installation and shall require subcontractors to provide and maintain the insurance required in the Schedule or elsewhere in the contract. The Contractor shall maintain a copy of all subcontractors' proofs of required insurance, and shall make copies available to the Contracting Officer upon request.

(End of clause)

**68. PLEDGES OF ASSETS (FEB 1992) FAR 52.228-11**

(a) Offerors shall obtain from each person acting as an individual surety on a bid guarantee, a performance bond, or a payment bond--

- (1) Pledge of assets; and
- (2) Standard Form 28, Affidavit of Individual Surety.

(b) Pledges of assets from each person acting as an individual surety shall be in the form of--

(1) Evidence of an escrow account containing cash, certificates of deposit, commercial or Government securities, or other assets described in FAR 28.203-2 (except see 28.203-2(b)(2) with respect to Government securities held in book entry form) and/or;

(2) A recorded lien on real estate. The offeror will be required to provide--

(i) Evidence of title in the form of a certificate of title prepared by a title insurance company approved by the United States Department of Justice. This title evidence must show fee simple title vested in the surety along with any concurrent owner; whether any real estate taxes are due and payable; and any recorded encumbrances against the property, including the lien filed in favor of the Government as required by FAR 28.203-3(d);

(ii) Evidence of the amount due under any encumbrance shown in the evidence of title;

(iii) A copy of the current real estate tax assessment of the property or a current appraisal dated no earlier than 6 months prior to the date of the bond, prepared by a professional appraiser who certifies that the appraisal has been conducted in accordance with the generally accepted appraisal standards as reflected in the Uniform Standards of Professional Appraisal Practice, as promulgated by the Appraisal Foundation.

(End of clause)

**69. PROSPECTIVE SUBCONTRACTOR REQUESTS FOR BONDS (OCT 1995)  
FAR 52.228-12**

In accordance with Section 806(a)(3) of Pub. L. 102-190, as amended by Sections 2091 and 8105 of Pub. L. 103-355, upon the request of a prospective subcontractor or supplier offering to furnish labor or material for the performance of this contract for which a payment bond has been furnished to the Government pursuant to the Miller Act, the Contractor shall promptly provide a copy of such payment bond to the requester.

(End of clause)

**70. FEDERAL, STATE, AND LOCAL TAXES (JAN 1991) FAR 52.229-3**

(a) "Contract date," as used in this clause, means the date set for bid opening or, if this is a negotiated contract or a modification, the effective date of this contract or modification

"All applicable Federal, State, and local taxes and duties," as used in this clause, means all taxes and duties, in effect on the contract date, that the taxing authority is imposing and collecting on the transactions or property covered by this contract.

"After-imposed Federal tax," as used in this clause, means any new or increased Federal excise tax or duty, or tax that was exempted or excluded on the contract date but whose exemption was later revoked or reduced during the contract period, on the transactions or property covered by this contract that the Contractor is required to pay or bear as the result of legislative, judicial, or administrative action taking effect after the contract date. It does not include social security tax or other employment taxes.

"After-relieved Federal tax," as used in this clause, means any amount of Federal excise tax or duty, except social security or other employment taxes, that would otherwise have been payable, on the transactions or property covered by this contract, but which the Contractor is not required to pay or bear, or for which the Contractor obtains a refund or drawback, as the result of legislative, judicial, or administrative action taking effect after the contract date.

(b) The contract price includes all applicable Federal, State, and local taxes and duties.

(c) The contract price shall be increased by the amount of any after-imposed Federal tax, provided the Contractor warrants in writing that no amount for such newly imposed Federal excise tax or duty or rate increase was included in the contract price, as a contingency reserve or otherwise.

(d) The contract price shall be decreased by the amount of any after-relieved Federal tax.

(e) The contract price shall be decreased by the amount of any Federal excise tax or duty, except social security or other employment taxes, that the Contractor is required to pay or bear, or does not obtain a refund of, through the Contractor's fault, negligence, or failure to follow instructions of the Contracting Officer.

(f) No adjustment shall be made in the contract price under this clause unless the amount of the adjustment exceed \$250.

(g) The Contractor shall promptly notify the Contracting Officer of all matters relating to any Federal excise tax or duty that reasonably may be expected to result in either an increase or decrease in the contract price and shall take appropriate action as the Contracting Officer directs.

(h) The Government shall, without liability, furnish evidence appropriate to establish exemption from any Federal, State, or local tax when the Contractor requests such evidence and a reasonable basis exists to sustain the exemption.

(End of clause)

## **71. SUPPLEMENTAL COST PRINCIPLES (DEC 1991) DFARS 52.231-7000**

When the allowability of costs under this contract is determined in accordance with Part 31 of the Federal Acquisition Regulation (FAR), allowability shall also be determined in accordance with Part 231 of the Defense FAR Supplement, in effect on the date of this contract.

(End of clause)

## **72. PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS (MAY 1997) FAR 52.232-5**

(a) *Payment of price.* The Government shall pay the Contractor the contract price as provided in this contract.

(b) *Progress payments.* The Government shall make progress payments monthly as the work proceeds, or at more frequent intervals as determined by the Contracting Officer, on estimates of work accomplished which meets the standards of quality established under the contract, as approved by the Contracting Officer.

(1) The Contractor's request for progress payments shall include the following substantiation:

(i) An itemization of the amounts requested, related to the various elements of work required by the contract covered by the payment requested.

(ii) A listing of the amount included for work performed by each subcontractor under the contract.

(iii) A listing of the amount included for work performed by each subcontract under the contract.

(iv) A listing of the amounts previously paid to each such subcontractor under the contract.

(v) Additional supporting data in a form and detail required by the Contracting Officer.

(2) In the preparation of estimates, the Contracting Officer may authorize material delivered on the site and preparatory work done to be taken into consideration. Material delivered to the Contractor at locations other than the site also may be taken into consideration if--

(i) Consideration is specifically authorized by this contract; and

(ii) The Contractor furnishes satisfactory evidence that it has acquired title to such material and that the material will be used to perform this contract.

(c) *Contractor certification.* Along with each request for progress payments, the Contractor shall furnish the following certification, or payment shall not be made: (However, if the Contractor elects to delete paragraph (c)(4) from the certification, the certification is still acceptable.)

I hereby certify, to the best of my knowledge and belief, that--

(1) The amounts requested are only for performance in accordance with the specifications, terms, and conditions of the contract;

(2) Payments to subcontractors and suppliers have been made from previous payments received under the contract, and timely payments will be made from the proceeds of the payment covered by this certification, in accordance with subcontract agreements and the requirements of chapter 39 of Title 31, United States Code; and

(3) This request for progress payments does not include any amounts which the prime contractor intends to withhold or retain from a subcontractor or supplier in accordance with the terms and conditions of the subcontract; and

(4) This certification is not to be construed as final acceptance of a subcontractor's performance.

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(Name)

---

(Title)

---

(Date)

(d) *Refund of unearned amounts.* If the Contractor, after making a certified request for progress payments, discovers that a portion or all of such request constitutes a payment for performance by the Contractor that fails to conform to the specifications, terms, and conditions of this contract (hereinafter referred to as the “unearned amount”), the Contractor shall--

(1) Notify the Contracting Officer of such performance deficiency; and  
(2) Be obligated to pay the Government an amount (computed by the Contracting Officer in the manner provided in paragraph (j) of this clause) equal to interest on the unearned amount from the date of receipt of the unearned amount until--

(i) The date the Contractor notifies the Contracting Officer that the performance deficiency has been corrected; or

(ii) The date the Contractor reduces the amount of any subsequent certified request for progress payments by an amount equal to the unearned amount.

(e) *Retainage.* If the Contracting Officer finds that satisfactory progress was achieved during any period for which a progress payment is to be made, the Contracting Officer shall authorize payment to be made in full. However, if satisfactory progress has not been made, the Contracting Officer may retain a maximum of 10 percent of the amount of the payment until satisfactory progress is achieved. When the work is substantially complete, the Contracting Officer may retain from previously withheld funds and future progress payments that amount the Contracting Officer considers adequate for protection of the Government and shall release to the Contractor all the remaining withheld funds. Also, on completion and acceptance of each separate building, public work, or other division of the contract, for which the price is stated separately in the contract, payment shall be made for the completed work without retention of a percentage.

(f) *Title, liability, and reservation of rights.* All material and work covered by progress payments made shall, at the time of payment, become the sole property of the Government, but this shall not be construed as--

(1) Relieving the Contractor from the sole responsibility for all material and work upon which payments have been made or the restoration of any damaged work; or

(2) Waiving the right of the Government to require the fulfillment of all of the terms of the contract.

(g) *Reimbursement for bond premiums.* In making these progress payments, the Government shall, upon request, reimburse the Contractor for the amount of premiums paid for performance and payment bonds (including coinsurance and reinsurance agreements, when applicable) after the Contractor has furnished evidence of full payment to the surety. The retainage provisions in paragraph (e) of this clause shall not apply to that portion of progress payments attributable to bond premiums.

(h) *Final payment.* The Government shall pay the amount due the Contractor under this contract after--

(1) Completion and acceptance of all work;

(2) Presentation of a properly executed voucher; and

(3) Presentation of release of all claims against the Government arising by virtue of this contract, other than claims, in stated amounts, that the Contractor has specifically excepted from the operation of the release. A release may also be required of the assignee if the Contractor's claim to amounts payable under this contract has been assigned under the Assignment of Claims Act of 1940 (31 U.S.C. 3727 and 41 U.S.C. 15).

(i) *Limitation because of undefinitized work.* Notwithstanding any provision of this contract, progress payments shall not exceed 80 percent on work accomplished on undefinitized contract actions. A “contract action” is any action resulting in a contract, as defined in FAR Subpart 2.1, including contract modifications for additional supplies or services, but not including contract modifications that are within the scope and under the terms of the contract, such as contract modifications issued pursuant to the Changes clause, or funding and other administrative changes.

(j) *Interest computation on unearned accounts.* In accordance with 31 U.S.C. 3903(c)(1), the amount payable under subparagraph (d)(2) of this clause shall be--

(1) Computed at the rate of average bond equivalent rates of 91-day Treasury bills auctioned at the most recent auction of such bills prior to the date the Contractor receives the unearned amount; and

(2) Deducted from the next available payment to the Contractor.

(End of clause)

### **73. INTEREST (JUNE 1996) FAR 52.232-17**

(a) Except as otherwise provided in this contract under a Price Reduction for Defective Cost or Pricing Data clause or a Cost Accounting Standards clause, all amounts that become payable by the Contractor to the Government under this contract (net of any applicable tax credit under the Internal Revenue Code (26 U.S.C. 1481)) shall bear simple interest from the date due until paid unless paid within 30 days of becoming due. The interest rate shall be the interest rate established by the Secretary of the Treasury as provided in Section 12 of the Contract Disputes Act of 1978 (Public Law 95-563), which is applicable to the period in which the amount becomes due, as provided in paragraph (b) of this clause, and then at the rate applicable for each six-month period as fixed by the Secretary until the amount is paid.

(b) Amounts shall be due at the earliest of the following dates:

(1) The date fixed under this contract.

(2) The date of the first written demand for payment consistent with this contract, including any demand resulting from a default termination.

(3) The date the Government transmits to the Contractor a proposed supplemental agreement to confirm completed negotiations establishing the amount of debt.

(4) If this contract provides for revision of prices, the date of written notice to the Contractor stating the amount of refund payable in connection with a pricing proposal or a negotiated pricing agreement not confirmed by contract modification.

(c) The interest charge made under this clause may be reduced under the procedures prescribed in 32.614-2 of the Federal Acquisition Regulation in effect on the date of this contract.

(End of clause)

#### **74. ASSIGNMENT OF CLAIMS (JAN 1986) ALTERNATE I (APR 1984) FAR 52.232-23 I**

(a) The Contractor, under the Assignment of Claims Act, as amended, 31 U.S.C. 3727, 41 U.S.C. 15 (hereafter referred to as "the Act"), may assign its rights to be paid amounts due or to become due as a result of the performance of this contract to a bank, trust company, or other financing institution, including any Federal lending agency. The assignee under such an assignment may thereafter further assign or reassign its right under the original assignment to any type of financing institution described in the preceding sentence. Unless otherwise stated in this contract, payments to an assignee of any amounts due or to become due under this contract shall not, to the extent specified in the Act, be subject to reduction or setoff.

(b) Any assignment or reassignment authorized under the Act and this clause shall cover all unpaid amounts payable under this contract, and shall not be made to more than one party, except that an assignment or reassignment may be made to one party as agent or trustee for two or more parties participating in the financing of this contract.

(c) The Contractor shall not furnish or disclose to any assignee under this contract any classified document (including this contract) or information related to work under this contract until the Contracting Officer authorizes such action in writing.

(End of clause)

#### **75. PROMPT PAYMENT FOR CONSTRUCTION CONTRACTS (JUN 1997) FAR 52.232-27**

Notwithstanding any other payment terms in this contract, the Government will make invoice payments and contract financing payments under the terms and conditions specified in this clause. Payment shall be considered as being made on the day a check is dated or an electronic funds transfer. Definitions of pertinent terms are set forth in 32.902 of the Federal Acquisition Regulation. All days referred to in this clause are calendar days, unless otherwise specified. (However, see subparagraph (a)(3) concerning payments due on Saturdays, Sundays, and legal holidays.)

(a) *Invoice Payments--(1) Types of invoice payments.* For purposes of this clause, there are several types of invoice payments which may occur under this contract, as follows:

(i) Progress payments, if provided for elsewhere in this contract, based on Contracting Officer approval of the estimated amount and value of work or services performed, including payments for reaching milestones in any project:

(A) The due date for making such payments shall be 14 days after receipt of the payment request by the designated billing office. However, if the designated billing office fails to annotate the payment request with the actual date of receipt at the time of receipt, the payment due date shall be the 14th day after the date of the Contractor's payment request, provided a proper payment request is received and there is no disagreement over quantity, quality, or Contractor compliance with contract requirements.



- (B) The due date for payment of any amounts retained by the Contracting Officer in accordance with the clause at 52.232-5, Payments Under Fixed-Price Construction Contracts, shall be as specified in the contract or, if not specified 30 days after approval for release to the Contractor by the Contracting Officer.

(ii) Final payments based on completion and acceptance of all work and presentation of release of all claims against the Government arising by virtue of the contract, and payments for partial deliveries that have been accepted by the Government (e.g., each separate building, public work, or other division of the contract for which the price is stated separately in the contract):

- (A) The due date for making such payments shall be either the 30th day after receipt by the designated billing office of a proper invoice from the Contractor, or the 30th day after Government acceptance of the work or services completed by the Contractor, whichever is later. If the designated billing office fails to annotate the invoice with the date of actual receipt at the time of receipt, the invoice payment due date shall be deemed to be the 30th day after the date the Contractor's invoice, provided a proper invoice is received and there is no disagreement over quantity, quality, or Contractor compliance with contract requirements.
- (B) On a final invoice where the payment amount is subject to contract settlement actions (e.g., release of claims), acceptance shall be deemed to have occurred on the effective date of the contract settlement.

(2) *Contractor's invoice.* The Contractor shall prepare and submit invoices to the designated billing office specified in the contract. A proper invoice must include the items listed in paragraphs (a)(2)(i) through (a)(2)(ix) of this clause. If the invoice does not comply with these requirements, it shall be returned within 7 days after the date the designated billing office received the invoice, with a statement of the reasons why it is not a property invoice. Untimely notification will be taken into account in computing any interest penalty owed the Contractor in the manner described in subparagraph (a)(4) of this clause.

- (i) Name and address of the Contractor
- (ii) Invoice date. (The Contractor is encouraged to date invoices as close as possible to the date of mailing or transmission.)
- (iii) Contract number or other authorization for work or services performed (including order number and contract line item number).
- (iv) Description of work or services performed.
- (v) Delivery and payment terms (e.g., prompt payment discount terms).
- (vi) Name and address of Contractor official to whom payment is to be sent (must be the same as that in the contract or in a proper notice of assignment).
- (vii) Name (where practicable), title, phone number, and mailing address of person to be notified in event of a defective invoice.
- (viii) For payments described in paragraph (a)(1)(i) of this clause, substantiation of the amounts requested and certification in accordance with the requirements of the clause at 52.232-5, Payments Under Fixed-Price Construction Contracts.
- (ix) Any other information or documentation required by the contract.
- (x) While not required, the Contractor is strongly encouraged to assign an identification number to each invoice.

(3) *Interest penalty.* An interest penalty shall be paid automatically by the designated payment office, without request from the Contractor, if payment is not made by the due date and the conditions listed in subdivisions (a)(3)(i) through (a)(3)(iii) of this clause are met, if applicable. However, when the due date falls on a Saturday, Sunday, or legal holiday when Federal Government offices are closed and Government business is not expected to be conducted, payment will be made on the following business day without incurring a late payment interest penalty.

- (i) A proper invoice was received by the designated billing office.
- (ii) A receiving report or other Government documentation authorizing payment was processed and there was no disagreement over quantity, quality, Contractor compliance with any contract term or condition, or requested progress payment amount.
- (iii) In the case of a final invoice for any balance of funds due the Contractor for work or services performed, the amount was not subject to further contract settlement actions between the Government and the Contractor.

(4) *Computing penalty amount.* The interest penalty shall be at the rate established by the Secretary of the Treasury under section 12 of the Contract Disputes Act of 1978 (41 U.S.C. 611) that is in effect on the day after the due date, except where the interest penalty is prescribed by other governmental authority (e.g., tariffs). This rate is referred to

as the "Renegotiation Board Interest Rate," and it is published in the *Federal Register* semiannually on or about January 1 and July 1. The interest penalty shall accrue daily on the invoice principal payment amount approved by the Government until the payment date of such approved principal amount, and will be compounded in 30-day increments inclusive from the first day after the due date through the payment date. That is, interest accrued at the end of any 30-day period will be added to the approved invoice principal payment amount and be subject to interest penalties if not paid in the succeeding 30-day period. If the designated billing office failed to notify the Contractor of a defective invoice within the periods prescribed in subparagraph (a)(2) of this clause, the due date on the corrected invoice will be adjusted by subtracting the number of days taken beyond the prescribed notification of defects period. Any interest penalty owed the Contractor will be based on this adjusted due date. Adjustments will be made by the designated payment office for errors in calculating interest penalties.

(i) For the sole purpose of computing an interest penalty that might be due the Contractor for payments described in subdivision (a)(1)(ii) of this clause, Government acceptance or approval shall be deemed to have occurred constructively on the 7th day after the Contractor has completed the work or services in accordance with the terms and conditions of the contract. In the event that actual acceptance or approval occurs within the constructive acceptance or approval period the determination of an interest penalty shall be based on the actual date of acceptance or approval. Constructive acceptance or constructive approval requirements do not apply if there is a disagreement over quantity, quality, or Contractor compliance with a contract provision. These requirements also do not compel Government officials to accept work or services, approve Contractor estimates, perform contract administration functions, or make payment prior to fulfilling their responsibilities.

(ii) The following periods of the time will not be included in the determination of an interest penalty:

(A) The period taken to notify the Contractor of defects in invoices submitted to the Government, but this may not exceed 7 days.

(B) The period between the defects notice and resubmission of the corrected invoice by the Contractor.

(C) For incorrect electronic funds transfer (EFT) information, in accordance with the EFT clause of this contract

(iii) Interest penalties will not continue to accrue after the filing of a claim for such penalties under the clause at 52.233-1, Disputes, or for more than 1 year. Interest penalties of less than \$1.00 need not be paid.

(iv) Interest penalties are not required on payment delays due to disagreement between the Government and the Contractor over the payment amount or other issues involving contract compliance, or on amounts temporarily withheld or retained in accordance with the terms of the contract. Claims involving disputes, and any interest that may be payable, will be resolved in accordance with the clause at 52.233-1, Disputes.

(5) *Prompt payment discounts.* An interest penalty shall also be paid automatically by the designated payment office, without request from the Contractor, if a discount for prompt payment is taken improperly. The interest penalty will be calculated on the amount of discount taken for the period beginning with the first day after the end of the discount period through the date when the Contractor is paid.

(6) *Additional interest penalty.* (i) If this contract was awarded on or after October 1, 1989, a penalty amount, calculated in accordance with subdivision (a)(6)(iii) of this clause, shall be paid in addition to the interest penalty amount if the Contractor--

(A) Is owed an interest penalty of \$1 or more;

(B) Is not paid the interest penalty within 10 days after the date the invoice amount is paid; and

(C) Makes a written demand to the designated payment office for additional penalty payment, in accordance with subdivision (a)(6)(ii) of this clause, postmarked not later than 40 days after the date the invoice amount is paid.

(ii) (A) Contractors shall support written demands for additional penalty payments with the following data. No additional data shall be required. Contractors shall--

(1) Specifically assert that late payment interest is due under a specific invoice, and request payment of all overdue late payment interest penalty and such additional penalty as may be required;

(2) Attach a copy of the invoice on which the unpaid late payment interest was due; and

(3) State that payment of the principal has been received, including the date of receipt.

(B) Demands may be postmarked on or before the 40th day after payment was made, except that--

- (1) If the postmark is illegible or nonexistent, the demand must have been received and annotated with the date of receipt by the designated payment office on or before the 40th day after payment was made; or
- (2) If the postmark is illegible or nonexistent and the designated payment office fails to make the required annotation, the demand's validity will be determined by the date the Contractor has placed on the demand; provided such date is no later than the 40th day after payment was made.
- (iii) (A) The additional penalty shall be equal to 100 percent of any original late payment, except--
  - (1) The additional penalty shall not exceed \$5,000;
  - (2) The additional penalty shall never be less than \$25; and
  - (3) No additional penalty is owed if the amount of the underlying interest penalty is less than \$1.
- (B) If the interest penalty ceases to accrue in accordance with the limits stated in subdivision (a)(4)(iii) of this clause, the amount of the additional penalty shall be calculated on the amount of interest penalty that would have accrued in the absence of these limits, subject to the overall limits on the additional penalty specified in subdivision (a)(6)(iii)(a) of the clause.
- (C) For determining the maximum and minimum additional penalties, the test shall be the interest penalty due on each separate payment made for each separate contract. The maximum and minimum additional penalty shall not be based upon individual invoices unless the invoices are paid separately. Where payments are consolidated for disbursing purposes, the maximum and minimum additional penalty determination shall be made separately for each contract therein.
- (D) The additional penalty does not apply to payments regulated by other Government regulations (e.g., payments under utility contracts subject to tariffs and regulation).

(b) *Contract Financing Payments.* (1) *Due dates for recurring financing payments.* If this contract provides for contract financing, requests for payment shall be submitted to the designated billing office as specified in this contract or as directed by the Contracting Officer. Contract financing payment shall be made on the 30th day after receipt of a proper contract financing request by the designated billing office. In the event that an audit or other review of a specific financing request is required to ensure compliance with the terms and conditions of the contract, the designated payment office is not compelled to make payment by the due date specified.

(2) *Due dates for other contract financing.* For advance payments, loans, or other arrangements that do not involve recurring submissions of contract financing requests, payment shall be made in accordance with the corresponding contract terms or as directed by the Contracting Officer.

(3) *Interest penalty not applicable.* Contract financing payments shall not be assessed an interest penalty for payment delays.

(c) *Subcontract clause requirements.* The Contractor shall include in each subcontract for property or services (including a material supplier) for the purpose of performing this contract the following:

(1) *Prompt payment for subcontractors.* A payment clause which obligates the Contractor to pay the subcontractor for satisfactory performance under its subcontract not later than 7 days from receipt of payment out of such amounts as are paid to the Contractor under this contract.

(2) *Interest for subcontractors.* An interest penalty clause which obligates the Contractor to pay to the subcontractor an interest penalty for each payment not made in accordance with the payment clause--

(i) For the period beginning on the day after the required payment date and ending on the date on which payment of the amount due to made; and

(ii) Computed at the rate of interest established by the Secretary of the Treasury, and published in the *Federal Register*, for interest payments under section 12 of the Contract Disputes Act of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligations to pay an interest penalty.

(3) *Subcontract clause flowdown* A clause requiring each subcontractor to include a payment clause and an interest penalty clause conforming to the standards set forth in subparagraphs (c)(1) and (c)(2) of this clause in each of its subcontracts, and to require each of its subcontractors to include such clauses in their subcontracts with each lower-tier subcontractor or supplier.

(d) *Subcontract clause interpretation.* The clauses required by paragraph (c) of this clause shall not be construed to impair the right of Contractor or a subcontractor at any tier to negotiate, and to include in their subcontract, provisions that--

(1) *Retainage permitted.* Permit the Contractor or a subcontractor to retain (without cause) a specified percentage of each progress payment otherwise due to a subcontractor for satisfactory performance under the subcontract without incurring any obligation to pay a late payment interest penalty, in accordance with terms and conditions agreed to

by the parties to the subcontract, giving such recognition as the parties deem appropriate to the ability of a subcontractor to furnish a performance bond and payment bond;

(2) *Withholding permitted.* Permit the Contractor or subcontractor to make a determination that part or all of the subcontractor's request for payment may be withheld in accordance with the subcontract agreement; and

(3) *Withholding requirements.* Permit such withholding without incurring any obligation to pay a late payment penalty if--

(i) A notice conforming to the standards of paragraph (g) of this clause previously has been furnished to the subcontractor; and

(ii) A copy of any notice issued by a Contractor pursuant to subdivision (d)(3)(i) of this clause has been furnished to the Contracting Officer.

(e) *Subcontractor withholding procedures.* If a Contractor, after making a request for payment to the Government but before making a payment to a subcontractor for the subcontractor's performance covered by the payment request, discovers that all or a portion of the payment otherwise due such subcontractor is subject to withholding from the subcontractor in accordance with the subcontract agreement, then the Contractor shall--

(1) *Subcontractor notice.* Furnish to the subcontractor a notice conforming to the standards of paragraph (g) of this clause as soon as practicable upon ascertaining the cause giving rise to a withholding, but prior to the due date for subcontractor payment;

(2) *Contracting Officer notice.* Furnish to the Contracting Officer, as soon as practicable, a copy of the notice furnished to the subcontractor pursuant to subparagraph (e)(1) of this clause;

(3) *Subcontractor progress payment reduction.* Reduce the subcontractor's progress payment by an amount not to exceed the amount specified in the notice of withholding furnished under subparagraph (e)(1) of this clause;

(4) *Subsequent subcontractor payment.* Pay the subcontractor as soon as practicable after the correction of the identified subcontract performance deficiency, and--

(i) Make such payment within--

(A) Seven days after correction of the identified subcontract performance deficiency (unless the funds therefor must be recovered from the Government because of a reduction under subdivision (e)(5)(i)) of this clause; or

(B) Seven days after the Contractor recovers such funds from the Government; or

(ii) Incur an obligation to pay a late payment interest penalty computed at the rate of interest established by the Secretary of the Treasury, and published in the *Federal Register*, for interest payments under section 12 of the Contracts Disputes Act of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligation to pay an interest penalty;

(5) *Notice to Contracting Officer.* Notify the Contracting Officer upon--

(i) Reduction of the amount of any subsequent certified application for payment; or

(ii) Payment to the subcontractor of any withheld amounts of a progress payment, specifying--

(A) The amounts withheld under subparagraph (e)(1) of this clause; and

(B) The dates that such withholding began and ended; and

(6) *Interest to Government.* Be obligated to pay to the Government an amount equal to interest on the withheld payments (computed in the manner provided in 31 U.S.C. 3903(c)(1)), from the 8th day after receipt of the withheld amounts from the Government until--

(i) The day the identified subcontractor performance deficiency is corrected; or

(ii) The date that any subsequent payment is reduced under subdivision (e)(5)(i) of this clause.

(f) *Third-party deficiency reports.* (1) *Withholding from subcontractor.* If a Contractor, after making payment to a first-tier subcontractor, receives from a supplier or subcontractor of the first-tier subcontractor (hereafter referred to as a "second-tier subcontractor") a written notice in accordance with section 2 of the Act of August 24, 1935 (40 U.S.C. 270b, Miller Act), asserting a deficiency in such first-tier subcontractor's performance under the contract for which the Contractor may be ultimately liable, and the Contractor determines that all or a portion of future payments otherwise due such first-tier subcontractor is subject to withholding in accordance with the subcontract agreement, the Contractor may, without incurring an obligation to pay an interest penalty under subparagraph (e)(6) of this clause--

(i) Furnish to the first-tier subcontractor a notice conforming to the standards of paragraph (g) of this clause as soon as practicable upon making such determination; and

(ii) Withhold from the first-tier subcontractor's next available progress payment or payments an amount not to exceed the amount specified in the notice of withholding furnished under paragraph (f)(1)(i) of this clause.

(2) *Subsequent payment or interest charge.* As soon as practicable, but not later than 7 days after receipt of satisfactory written notification that the identified subcontract performance deficiency has been corrected, the Contractor shall (i) Pay the amount withheld under paragraph (f)(1)(ii) of this clause to such first-tier subcontractor; or (ii) Incur an obligation to pay a late payment interest penalty to such first-tier subcontractor computed at the rate of interest established

by the Secretary of the Treasury, and published in the *Federal Register*, for interest payments under section 12 of the Contracts Disputes Act of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligation to pay an interest penalty.

(g) *Written notice of subcontractor withholding.* A written notice of any withholding shall be issued to a subcontractor (with a copy to the Contracting Officer of any such notice issued by the Contractor), specifying--

- (1) The amount to be withheld;
- (2) The specific causes for the withholding under the terms of the subcontract; and
- (3) The remedial actions to be taken by the subcontractor in order to receive payment of the amounts withheld.

(h) *Subcontractor payment entitlement.* The Contractor may not request payment from the Government of any amount withheld or retained in accordance with paragraph (d) of this clause until such time as the Contractor has determined and certified to the Contracting Officer that the subcontractor is entitled to the payment of such amount.

(i) *Prime-subcontractor disputes.* A dispute between the Contractor and subcontractor relating to the amount or entitlement of a subcontractor to a payment or a late payment interest penalty under a clause included in the subcontract pursuant to paragraph (c) of this clause does not constitute a dispute to which the United States is a party. The United States may not be interpleaded in any judicial or administrative proceeding involving such a dispute.

(j) *Preservation of prime-subcontractor rights.* Except as provided in paragraph (i) of this clause, this clause shall not limit or impair any contractual, administrative, or judicial remedies otherwise available to the Contractor or a subcontractor in the event of a dispute involving late payment or nonpayment by the Contractor or deficient subcontract performance or nonperformance by a subcontractor.

(k) *Non-recourse for prime contractor interest penalty.* The Contractor's obligation to pay an interest penalty to a subcontractor pursuant to the clauses included in a subcontract under paragraph (c) of this clause shall not be construed to be an obligation of the United States for such interest penalty. A cost reimbursement claim may not include any amount for reimbursement of such interest penalty.

(End of clause)

## **76. PAYMENT BY ELECTRONIC FUNDS TRANSFER (CCR) (JUN 1998)**

### **DFARS 252.232-7009**

(a) Method of payment. (1) All payments by the Government under this contract shall be made by electronic funds transfer (EFT), except as provided in paragraph (a)(2) or (b) of this clause. As used in this clause, the term "EFT" refers to the funds transfer and may also include the payment information transfer.

(2) In the event the Government is unable to release one or more payments by EFT, the Contractor agrees to either (i) accept payment by check or some other mutually agreeable method of payment, or (ii) request the Government to extend the payment due date until such time as the Government can make payment by EFT (but see paragraph (e) of this clause).

(b) Alternative contractor certification. If the Contractor certifies in writing, as part of its registration with the Central Contractor Registration (CCR) database that it does not have an account with a financial institution and does not have an authorized payment agent, payment shall be made by check to the remittance address contained in the CCR database. All contractor certifications will expire on January 1, 1999.

(c) Contractor's EFT information. Except as provided in paragraph (b) of this clause, the Government shall make payment to the Contractor using the EFT information contained in the CCR database. In the event that the EFT information changes, the Contractor shall be responsible for providing the updated information to the CCR database.

(d) Mechanisms for EFT payment. The Government may make payment by EFT through either an Automated Clearing House subject to the banking laws of the United States or the Federal Reserve Wire Transfer System.

(e) Suspension of payment. If the Contractor's EFT information in the CCR database is incorrect and the Contractor has not certified under paragraph (b) of this clause, the Government need not make payment to the Contractor under this contract until correct EFT information or certification is entered into the CCR database; and any invoice or contract financing request shall be deemed not to be a proper invoice for the purpose of prompt payment under this contract. The prompt payment terms of the contract regarding notice of an improper invoice and delays in accrual of interest penalties apply.

(f) Contractor EFT arrangements. If the Contractor has identified multiple payment receiving points (i.e., more than one remittance address or EFT information set) in the CCR database, and the Contractor has not notified the Government of the payment receiving point applicable to this contract, the Government shall make payment to the first payment receiving point (EFT information set or remittance address as applicable) listed in the CCR database.

(g) Liability for uncompleted or erroneous transfers. (1) If an uncompleted or erroneous transfer occurs because the Government failed to use the Contractor's EFT information in the correct manner, the Government remains responsible for—

- (i) Making a correct payment;
- (ii) Paying any prompt payment penalty due; and
- (iii) Recovering any erroneously directed funds.

(2) If an uncompleted or erroneous transfer occurs because the Contractor's EFT information was incorrect, or was revised within 30 days of Government release of the EFT payment transaction instruction to the Federal Reserve System, and—

- (i) If the funds are no longer under the control of the payment office, the Government is deemed to have made payment and the contractor is responsible for recovery of any erroneously directed funds; or
- (ii) If the funds remain under the control of the payment office, the Government shall not make payment, and the provisions of paragraph (e) of this clause shall apply.

(h) EFT and prompt payment. A payment shall be deemed to have been made in a timely manner in accordance with the prompt payment terms of this contract if, in the EFT payment transaction instruction released to the Federal Reserve System, the date specified for settlement of the payment is on or before the prompt payment due date, provided the specified payment date is a valid date under the rules of the Federal Reserve System.

(i) EFT and assignment of claims. If the Contractor assigns the proceeds of this contract as provided for in the assignment of claims terms of this contract, the Contractor shall require as a condition of any such assignment, that the assignee register in the CCR database and be paid by EFT in accordance with the terms of this clause. In all respects, the requirements of this clause shall apply to the assignee as if it were the Contractor. EFT information that shows the ultimate recipient of the transfer to be other than the Contractor, in the absence of a proper assignment of claims acceptable to the Government, is incorrect EFT information within the meaning of paragraph (e) of this clause.

(j) Liability for change of EFT information by financial agent. The Government is not liable for errors resulting from changes to EFT information made by the Contractor's financial agent.

(k) Payment information. The payment or disbursing office shall forward to the Contractor available payment information that is suitable for transmission as of the date of release of the EFT instruction to the Federal Reserve System. The Government may request the Contractor to designate a desired format and method(s) for delivery of payment information from a list of formats and methods the payment office is capable of executing. However, the Government does not guarantee that any particular format or method of delivery is available at any particular payment office and retains the latitude to use the format and delivery method most convenient to the Government. If the Contractor has certified in accordance with paragraph (b) of this clause or if the Government otherwise make payment by check in accordance with paragraph (a) of this clause, the Government shall mail the payment information to the remittance address contained in the CCR database.

(End of clause)

## **77. REDUCTION OR SUSPENSION OF CONTRACT PAYMENTS UPON FINDING OF FRAUD (AUG 1992) DFARS 252.232-7006**

(a) 10 U.S.C. 2307(e) permits the head of the agency to reduce or suspend further payments to the Contractor upon a written determination by the agency head that substantial evidence exists that the Contractor's request for advance, partial, or progress payments is based on fraud. The provisions of 10 U.S.C. 2307(e) are in addition to any other rights or remedies provided the Government by law or under contract.

(b) Actions taken by the Government in accordance with 10 U.S.C. 2307(e) shall not constitute an excusable delay under the Default clause of this contract or otherwise relieve the Contractor of its obligations to perform under this contract.

(End of clause)

## **78. DISPUTES (OCT 1995) FAR 52.233-1**

(a) This contract is subject to the Contract Disputes Act of 1978, as amended (41 U.S.C. 601-613).

(b) Except as provided in the Act, all disputes arising under or relating to this contract shall be resolved under this clause.

(c) "Claim," as used in this clause, means a written demand or written assertion by one of the contracting parties seeking, as a matter of right, the payment of money in a sum certain, the adjustment or interpretation of contract terms, or other relief arising under or relating to this contract. A claim arising under a contract, unlike a claim relating to that contract, is a claim that can be resolved under a contract clause that provides for the relief sought by the claimant. However, a written demand or written assertion by the Contractor seeking the payment of money exceeding \$100,000 is not a claim under the Act until certified as required by subparagraph (d)(2) of this clause. A voucher, invoice, or other routine request for payment that is not in dispute when submitted is not a claim under the Act. The submission may be

converted to a claim under the Act, by complying with the submission and certification requirements of this clause, if it is disputed either as to liability or amount or is not acted upon in a reasonable time.

(d)(1) A claim by the Contractor shall be made in writing and, unless otherwise stated in this contract, submitted within 6 years after accrual of the claim to the Contracting Officer for a written decision. A claim by the Government against the Contractor shall be subject to a written decision by the Contracting Officer.

(2)(i) Contractors shall provide the certification specified in subparagraph (d)(2)(iii) of this clause when submitting any claim--

(A) Exceeding \$100,000; or

(B) Regardless of the amount claimed, when using--

(1) Arbitration conducted pursuant to 5 U.S.C. 575-580; or

(2) Any other alternative means of dispute resolution (ADR) technique that the agency elects to handle in accordance with the Administrative Dispute Resolution Act (ADRA).

(ii) The certification requirement does not apply to issues in controversy that have not been submitted as all or part of a claim.

(iii) The certification shall state as follows: "I certify that the claim is made in good faith; that the supporting data are accurate and complete to the best of my knowledge and belief; that the amount requested accurately reflects the contract adjustment for which the Contractor believes the Government is liable; and that I am duly authorized to certify the claim on behalf of the Contractor."

(3) The certification may be executed by any person duly authorized to bind the Contractor with respect to the claim.

(e) For Contractor claims of \$100,000 or less, the Contracting Officer must, if requested in writing by the Contractor, render a decision within 60 days of the request. For Contractor-certified claims over \$100,000, the Contracting Officer must, within 60 days, decide the claim or notify the Contractor of the date by which the decision will be made.

(f) The Contracting Officer's decision shall be final unless the Contractor appeals or files a suit as provided in the Act.

(g) If the claim by the Contractor is submitted to the Contracting Officer or a claim by the Government is presented to the Contractor, the parties, by mutual consent, may agree to use ADR. If the Contractor refuses an offer for alternative disputes resolution, the Contractor shall inform the Contracting Officer, in writing, of the Contractor's specific reasons for rejecting the request. When using arbitration conducted pursuant to 5 U.S.C. 575-580, or when using any other ADR technique that the agency elects to handle in accordance with the ADRA, any claim, regardless of amount, shall be accompanied by the certification described in subparagraph (d)(2)(iii) of this clause, and executed in accordance with subparagraph (d)(3) of this clause.

(h) The government shall pay interest on the amount found due and unpaid from (1) the date that the Contracting Officer receives the claim (certified, if required); or (2) the date that payment otherwise would be due, if that date is later, until the date of payment. With regard to claims having defective certification, as defined in FAR 33.201, interest shall be paid from the date that the Contracting Officer initially receives the claim. Simple interest on claim shall be paid at the rate, fixed by the Secretary of the Treasury as provided in the Act, which is applicable to the period during which the Contracting Officer receives the claim and then at the rate applicable for each 6-month period as fixed by the Treasury Secretary during the pendency of the claim.

(i) The Contractor shall proceed diligently with performance of this contract, pending final resolution of any request for relief, claim, appeal, or action arising under the contract, and comply with any decision of the Contracting Officer.

(End of clause)

## **79. PROTEST AFTER AWARD (AUG 1996) FAR 52.233-3**

(a) Upon receipt of a notice of protest (as defined in FAR 33.101) or a determination that a protest is likely (see FAR 33.102(d)), the Contracting Officer may, by written order to the Contractor, direct the Contractor to stop performance of the work called for by this contract. The order shall be specifically identified as a stop-work order issued under this clause. Upon receipt of the order, the Contractor shall immediately comply with its terms and take all reasonable steps to minimize the incurrence of costs allocable to the work covered by the order during the period of work stoppage. Upon receipt of the final decision in the protest, the Contracting Officer shall either--

(1) Cancel the stop-work order; or

(2) Terminate the work covered by the order as provided in the Default, or the Termination for Convenience of the Government, clause of this contract.

(b) If a stop-work order issued under this clause is canceled either before or after a final decision in the protest, the Contractor shall resume work. The Contracting Officer shall make an equitable adjustment in the delivery schedule or contract price, or both, and the contract shall be modified, in writing, accordingly, if--

(1) The stop-work order results in an increase in the time required for, or in the Contractor's cost properly allocable to, the performance of any part of this contract; and

(2) The Contractor asserts its right to an adjustment within 30 days after the end of the period of work stoppage; *provided*, that if the Contracting Officer decides the facts justify the action, the Contracting Officer may receive and act upon a proposal submitted at any time before final payment under this contract.

(c) If a stop-work order is not canceled and the work covered by the order is terminated for the convenience of the Government, the Contracting Officer shall allow reasonable costs resulting from the stop-work order in arriving at the termination settlement.

(d) If a stop-work order is not canceled and the work covered by the order is terminated for default, the Contracting Officer shall allow, by equitable adjustment or otherwise, reasonable costs resulting from the stop-work order.

(e) The Government's rights to terminate this contract at any time are not affected by action taken under this clause.

(f) If, as the result of the Contractor's intentional or negligent misstatement, misrepresentation, or miscertification, a protest related to this contract is sustained, and the Government pays costs, as provided in FAR 33.102(b)(2) or 33.104(h)(1), the Government may require the Contractor to reimburse the Government the amount of such costs. In addition to any other remedy available, and pursuant to the requirements of Subpart 32.6, the Government may collect this debt by offsetting the amount against any payment due the Contractor under any contract between the Contractor and the Government.

(End of clause)

#### **80. DIFFERING SITE CONDITIONS (APR 1984) FAR 52.236-2**

(a) The Contractor shall promptly, and before the conditions are disturbed, give a written notice to the Contracting Officer of (1) subsurface or latent physical conditions at the site which differ materially from those indicated in this contract, or (2) unknown physical conditions at the site, of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inhering in work of the character provided for in the contract.

(b) The Contracting Officer shall investigate the site conditions promptly after receiving the notice. If the conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performing any part of the work under this contract, whether or not changed as a result of the conditions, an equitable adjustment shall be made under this clause and the contract modified in writing accordingly.

(c) No request by the Contractor for an equitable adjustment to the contract under this clause shall be allowed, unless the Contractor has given the written notice required; *provided*, that the time prescribed in paragraph (a) of this clause for giving written notice may be extended by the Contracting Officer.

(d) No request by the Contractor for an equitable adjustment to the contract for differing site conditions shall be allowed if made after final payment under this contract.

(End of clause)

#### **81. SITE INVESTIGATION AND CONDITIONS AFFECTING THE WORK (APR 1984) FAR 52.236-3**

(a) The Contractor acknowledges that it has taken steps reasonably necessary to ascertain the nature and location of the work, and that it has investigated and satisfied itself as to the general and local conditions which can affect the work or its cost, including but not limited to (1) conditions bearing upon transportation, disposal, handling, and storage of materials; (2) the availability of labor, water, electric power, and roads; (3) uncertainties of weather, river stages, tides, or similar physical conditions at the site; (4) the conformation and conditions of the ground; and (5) the character of equipment and facilities needed preliminary to and during work performance. The Contractor also acknowledges that it has satisfied itself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as to this information is reasonably ascertainable from an inspection of the site, including all exploratory work done by the Government, as well as from the drawings and specifications made a part of this contract. Any failure of the Contractor to take the actions described and acknowledged in this paragraph will not relieve the Contractor from responsibility for estimating properly the difficulty and cost of successfully performing the work, or for proceeding to successfully perform the work without additional expense to the Government.

(b) The Government assumes no responsibility for any conclusions or interpretations made by the Contractor based on the information made available by the Government. Nor does the Government assume responsibility for any



understanding reached or representation made concerning conditions that can affect the work by any of its officers or agents before the execution of this contract, unless that understanding or representation is expressly stated in this contract.  
(End of clause)

**82. MATERIAL AND WORKMANSHIP (APR 1984) FAR 52.236-5**

(a) All equipment, material, and articles incorporated into the work covered by this contract shall be new and of the most suitable grade for the purpose intended, unless otherwise specifically provided in this contract. References in the specifications to equipment, material, articles, or patented processes by trade name, make, or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition. The Contractor may, at its option, use any equipment, material, article, or process that, in the judgment of the Contracting Officer, is equal to that named in the specifications, unless otherwise specifically provided in this contract.

(b) The Contractor shall obtain the Contracting Officer's approval of the machinery and mechanical and other equipment to be incorporated into the work. When requesting approval, the Contractor shall furnish to the Contracting Officer the name of the manufacturer, the model number, and other information concerning the performance, capacity, nature, and rating of the machinery and mechanical and other equipment. When required by this contract or by the Contracting Officer, the Contractor shall also obtain the Contracting Officer's approval of the material or articles which the Contractor contemplates incorporating into the work. When requesting approval, the Contractor shall provide all information concerning the material or articles. When directed to do so, the Contractor shall submit samples for approval at the Contractor's expense, with all shipping at the Contractor's expense, with all shipping charges prepaid. Machinery, equipment, material, and articles that do not have the required approval shall be installed or used at the risk of subsequent rejection.

(c) All work under this contract shall be performed in a skillful and workmanlike manner. The Contracting Officer may require, in writing, that the Contractor remove from the work any employee the Contracting Officer deems incompetent, careless, or otherwise objectionable.

(End of clause)

**83. SUPERINTENDENCE BY THE CONTRACTOR (APR 1984) FAR 52.236-6**

At all times during performance of this contract and until the work is completed and accepted, the Contractor shall directly superintend the work or assign and have on the worksite a competent superintendent who is satisfactory to the Contracting Officer and has authority to act for the Contractor.

(End of clause)

**84. PERMITS AND RESPONSIBILITIES (NOV 1991) FAR 52.236-7**

The Contractor shall, without additional expense to the Government, be responsible for obtaining any necessary licenses and permits, and for complying with any Federal, State, and municipal laws, codes, and regulations applicable to the performance of the work. The Contractor shall also be responsible for all damages to persons or property that occur as a result of the Contractor's fault or negligence. The Contractor shall also be responsible for all materials delivered and work performed until completion and acceptance of the entire work, except for any completed unit of work which may have been accepted under the contract.

(End of clause)

**85. OTHER CONTRACTS (APR 1984) FAR 52.236-8**

The Government may undertake or award other contracts for additional work at or near the site of the work under this contract. The Contractor shall fully cooperate with the other contractors and with Government employees and shall carefully adapt scheduling and performing the work under this contract to accommodate the additional work, heeding any direction that may be provided by the Contracting Officer. The Contractor shall not commit or permit any act that will interfere with the performance of work by any other contractor or by Government employees.

(End of clause)

**86. PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS (APR 1984) FAR 52.236-9**

(a) The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer.

(b) The Contractor shall protect from damage all existing improvements and utilities (1) at or near the work site, and (2) on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

(End of clause)

## **87. OPERATIONS AND STORAGE AREAS (APR 1984) FAR 52.236-10**

(a) The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Contracting Officer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.

(b) Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed.

(c) The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.

(End of clause)

## **88. USE AND POSSESSION PRIOR TO COMPLETION (APR 1984) FAR 52.236-11**

(a) The Government shall have the right to take possession of or use any completed or partially completed part of the work. Before taking possession of or using any work, the Contracting Officer shall furnish the Contractor a list of items of work remaining to be performed or corrected on those portions of the work that the Government intends to take possession of or use. However, failure of the Contracting Officer to list any item of work shall not relieve the Contractor of responsibility for complying with the terms of the contract. The Government's possession or use shall not be deemed an acceptance of any work under the contract.

(b) While the Government has such possession or use, the Contractor shall be relieved of the responsibility for the loss of or damage to the work resulting from the Government's possession or use, notwithstanding the terms of the clause in this contract entitled "Permits and Responsibilities." If prior possession or use by the Government delays the progress of the work or causes additional expense to the Contractor, an equitable adjustment shall be made in the contract price or the time of completion, and the contract shall be modified in writing accordingly.

(End of clause)

## **89. CLEANING UP (APR 1984) FAR 52.236-12**

The Contractor shall at all times keep the work area, including storage areas, free from accumulations of waste materials. Before completing the work, the Contractor shall remove from the work and premises any rubbish, tools, scaffolding, equipment, and materials that are not the property of the Government. Upon completing the work, the Contractor shall leave the work area in a clean, neat, and orderly condition satisfactory to the Contracting Officer.

(End of clause)

## **90. ACCIDENT PREVENTION (NOV 1991)--ALTERNATE I (NOV 1991) FAR 52.236-13 I**

(a) The Contractor shall provide and maintain work environments and procedures which will (1) safeguard the public and Government personnel, property, materials, supplies, and equipment exposed to Contractor operations and activities; (2) avoid interruptions of Government operations and delays in project completion dates; and (3) control costs in the performance of this contract.

(b) For these purposes on contracts for construction or dismantling, demolition, or removal of improvements, the Contractor shall--

(1) Provide appropriate safety barricades, signs, and signal lights;

(2) Comply with the standards issued by the Secretary of Labor at 29 CFR Part 1926 and 29 CFR Part 1910; and

(3) Ensure that any additional measures the Contracting Officer determines to be reasonably necessary for the purposes are taken.

(c) If this contract is for construction or dismantling, demolition or removal of improvements with any Department of Defense agency or component, the Contractor shall comply with all pertinent provisions of the latest version of U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, in effect on the date of the solicitation.

(d) Whenever the Contracting Officer becomes aware of any noncompliance with these requirements or any condition which poses a serious or imminent danger to the health or safety of the public or Government personnel, the Contracting Officer shall notify the Contractor orally, with written confirmation, and request immediate initiation of corrective action. This notice, when delivered to the Contractor or the Contractor's representative at the work site, shall be deemed sufficient notice of the noncompliance and that corrective action is required. After receiving the notice, the Contractor shall immediately take corrective action. If the Contractor fails or refuses to promptly take corrective action, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. The Contractor shall not be entitled to any equitable adjustment of the contract price or extension of the performance schedule on any stop work order issued under this clause.

(e) The Contractor shall insert this clause, including this paragraph (e), with appropriate changes in the designation of the parties, in subcontracts.

(f) Before commencing the work, the Contractor shall--

(1) Submit a written proposed plan for implementing this clause. The plan shall include an analysis of the significant hazards to life, limb, and property inherent in contract work performance and a plan for controlling these hazards; and

(2) Meet with representatives of the Contracting Officer to discuss and develop a mutual understanding relative to administration of the overall safety program.

(End of clause)

## **91. SCHEDULES FOR CONSTRUCTION CONTRACTS (APR 1984) FAR 52.236-15**

(a) The Contractor shall, within five days after the work commences on the contract or another period of time determined by the Contracting Officer, prepare and submit to the Contracting Officer for approval three copies of a practicable schedule showing the order in which the Contractor proposes to perform the work, and the dates on which the Contractor contemplates starting and completing the several salient features of the work (including acquiring materials, plant, and equipment). The schedule shall be in the form of a progress chart of suitable scale to indicate appropriately the percentage of work scheduled for completion by any given date during the period. If the Contractor fails to submit a schedule within the time prescribed, the Contracting Officer may withhold approval of progress payment until the Contractor submits the required schedule.

(b) The Contractor shall enter the actual progress on the chart as directed by the Contracting Officer, and upon doing so shall immediately delivery three copies of the annotated schedule to the Contracting Officer. If, in the opinion of the Contracting Officer, the Contractor falls behind the approved schedule, the Contractor shall take steps necessary to improve its progress, including those that may be required by the Contracting Officer, without additional cost to the Government. In this circumstance, the Contracting Officer may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction plant, and to submit for approval any supplementary schedule or schedules in chart form as the Contracting Officer deems necessary to demonstrate how the approved rate of progress will be regained.

(c) Failure of the Contractor to comply with the requirements of the Contracting Officer under this clause shall be grounds for a determination by the Contracting Officer that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the contract. Upon making this determination, the Contracting

Officer may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the default terms of this contract.

(End of clause)

**92. SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FEB 1997)  
FAR 52.236-21**

(a) The Contractor shall keep on the work site a copy of the drawings and specifications and shall at all times give the Contracting Officer access thereto. Anything mentioned in the specifications and not shown on the drawings, or shown on the drawings and not mentioned in the specifications, shall be of like effect as if shown or mentioned in both. In case of difference between drawings and specifications, the specifications shall govern. In case of discrepancy in the figures, in the drawings, or in the specifications, the matter shall be promptly submitted to the Contracting Officer, who shall promptly make a determination in writing. Any adjustment by the Contractor without such a determination shall be at its own risk and expense. The Contracting Officer shall furnish from time to time such detailed drawings and other information as considered necessary, unless otherwise provided.

(b) Wherever in the specifications or upon the drawings the words "directed", "required", "ordered", "designated", "prescribed", or words of like import are used, it shall be understood that the "direction", "requirement", "order", "designation", or "prescription", of the Contracting Officer is intended and similarly the words "approved", "acceptable", "satisfactory", or words of like import shall mean "approved by," or "acceptable to", or "satisfactory to" the Contracting Officer, unless otherwise expressly stated.

(c) Where "as shown", "as indicated", "as detailed", or words of similar import are used, it shall be understood that reference is made to the drawings accompanying this contract unless stated otherwise. The word "provided" as used herein shall be understood to mean "provide complete in place", that is furnished and installed".

(d) Shop drawings means drawings, submitted to the Government by the Contractor, subcontractor, or any lower tier subcontractor pursuant to a construction contract, showing in detail (1) the proposed fabrication and assembly of structural elements and (2) the installation (i.e., fit, and attachment details) of materials or equipment. It includes drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials furnished by the contractor to explain in detail specific portions of the work required by the contract. The Government may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.

(e) If this contract requires shop drawings, the Contractor shall coordinate all such drawings, and review them for accuracy, completeness, and compliance with contract requirements and shall indicate its approval thereon as evidence of such coordination and review. Shop drawings submitted to the Contracting Officer without evidence of the Contractor's approval may be returned for resubmission. The Contracting Officer will indicate an approval or disapproval of the shop drawings and if not approved as submitted shall indicate the Government's reasons therefor. Any work done before such approval shall be at the Contractor's risk. Approval by the Contracting Officer shall not relieve the Contractor from responsibility for any errors or omissions in such drawings, nor from responsibility for complying with the requirements of this contract, except with respect to variations described and approved in accordance with (f) below.

(f) If shop drawings show variations from the contract requirements, the Contractor shall describe such variations in writing, separate from the drawings, at the time of submission. If the Contracting Officer approves any such variation, the Contracting Officer shall issue an appropriate contract modification, except that, if the variation is minor or does not involve a change in price or in time of performance, a modification need not be issued.

(g) The Contractor shall submit to the Contracting Officer for approval four copies (unless otherwise indicated) of all shop drawings as called for under the various headings of these specifications. Three sets (unless otherwise indicated) of all shop drawings, will be retained by the Contracting Officer and one set will be returned to the Contractor.

(End of clause)

**93. PRECONSTRUCTION CONFERENCE (FEB 1995) FAR 52.236-26**

If the Contracting Officer decides to conduct a preconstruction conference, the successful offeror will be notified and will be required to attend. The Contracting Officer's notification will include specific details regarding the date, time, and location of the conference, any need for attendance by subcontractors, and information regarding the items to be discussed.

(End of clause)

**94. MODIFICATION PROPOSALS--PRICE BREAKDOWN (DEC 1991)  
DFARS 252.236-7000**

(a) The Contractor shall furnish a price breakdown, itemized as required and within the time specified by the Contracting Officer, with any proposal for a contract modification.

(b) The price breakdown--

(1) Must include sufficient detail to permit analysis of profit, and of all costs for--

(i) Material;

(ii) Labor;

(iii) Equipment;

(iv) Subcontracts; and

(v) Overhead; and

(2) Must cover all work involved in the modification, whether the work was deleted, added, or changed.

(c) The Contractor shall provide similar price breakdowns to support any amounts claimed for subcontracts.

(d) The Contractor's proposal shall include a justification for any time extension proposed.

(End of clause)

#### **95. BANKRUPTCY (JUL 1995) FAR 52.242-13**

In the event the Contractor enters into proceedings relating to bankruptcy, whether voluntary or involuntary, the Contractor agrees to furnish, by certified mail or electronic commerce method authorized by the contract, written notification of the bankruptcy to the Contracting Officer responsible for administering the contract. This notification shall be furnished within five days of the initiation of the proceedings relating to bankruptcy filing. This notification shall include the date on which the bankruptcy petition was filed, the identity of the court in which the bankruptcy petition was filed, and a listing of Government contract numbers and contracting offices for all Government contracts against which final payment has not been made. This obligation remains in effect until final payment under this contract.

(End of clause)

#### **96. SUSPENSION OF WORK (APR 1984) FAR 52.242-14**

(a) The Contracting Officer may order the Contractor, in writing, to suspend, delay, or interrupt all or any part of the work of this contract for the period of time that the Contracting Officer determines appropriate for the convenience of the Government.

(b) If the performance of all or any part of the work is, for an unreasonable period of time, suspended, delayed, or interrupted (1) by an act of the Contracting Officer in the administration of this contract, or (2) by the Contracting Officer's failure to act within the time specified in this contract (or within a reasonable time if not specified), an adjustment shall be made for any increase in the cost of performance of this contract (excluding profit) necessarily caused by the unreasonable suspension, delay, or interruption, and the contract modified in writing accordingly. However, no adjustment shall be made under this clause for any suspension, delay, or interruption to the extent that performance would have been so suspended, delayed, or interrupted by any other cause, including the fault or negligence of the Contractor, or for which an equitable adjustment is provided for or excluded under any other term or condition of this contract.

(c) A claim under this clause shall not be allowed (1) for any costs incurred more than 20 days before the Contractor shall have notified the Contracting Officer in writing of the act or failure to act involved (but this requirement shall not apply as to a claim resulting from a suspension order), and (2) unless the claim, in an amount stated, is asserted in writing as soon as practicable after the termination of the suspension, delay, or interruption, but not later than the date of final payment under the contract.

(End of clause)

#### **97. POSTAWARD CONFERENCE (DEC 1991) DFARS 252.242-7000**

The Contractor agrees to attend any postaward conference convened by the contracting activity or contract administration office in accordance with Federal Acquisition Regulation Subpart 42.5.

(End of clause)

#### **98. CHANGES (AUG 1987) FAR 52.243-4**

(a) The Contracting Officer may, at any time, without notice to the sureties, if any, by written order designated or indicated to be a change order, make changes in the work within the general scope of the contract, including changes--

- (1) In the specifications (including drawings and designs);
- (2) In the method or manner or performance of the work;
- (3) In the Government-furnished facilities, equipment, materials, services, or site; or
- (4) Directing acceleration in the performance of the work.

(b) Any other written or oral order (which, as used in this paragraph (b), includes direction, instruction, interpretation, or determination) from the Contracting Officer that causes a change shall be treated as a change order under this clause; *provided*, that the Contractor gives the Contracting Officer written notice stating (1) the date, circumstances, and source of the order and (2) that the Contractor regards the order as a change order.

(c) Except as provided in this clause, no order, statement, or conduct of the Contracting Officer shall be treated as a change under this clause or entitle the Contractor to an equitable adjustment.

(d) If any change under this clause causes an increase or decrease in the Contractor's cost of, or the time required for, the performance of any part of the work under this contract, whether or not changed by any such order, the Contracting Officer shall make an equitable adjustment and modify the contract in writing. However, except for an adjustment based on defective specifications, no adjustment for any change under paragraph (b) of this clause shall be made for any costs incurred more than 20 days before the Contractor gives written notice as required. In the case of defective specifications for which the Government is responsible, the equitable adjustment shall include any increased cost reasonably incurred by the Contractor in attempting to comply with the defective specifications.

(e) The Contractor must assert its right to an adjustment under this clause within 30 days after (1) receipt of a written change order under paragraph (a) of this clause or (2) the furnishing of a written notice under paragraph (b) of this clause, by submitting to the Contracting Officer a written statement describing the general nature and amount of proposal, unless this period is extended by the Government. The statement of proposal for adjustment may be included in the notice under paragraph (b) above.

(f) No proposal by the Contractor for an equitable adjustment shall be allowed if asserted after final payment under this contract.

(End of clause)

#### **99. PRICING OF CONTRACT MODIFICATIONS (DEC 1991) DFARS 252.243-7001**

When costs are a factor in any price adjustment under this contract, the contract cost principles and procedures in FAR Part 31 and DFARS Part 231, in effect on the date of this contract, apply.

(End of clause)

#### **100. CERTIFICATION OF REQUESTS FOR EQUITABLE ADJUSTMENT (JUL 1997) DFARS 252.243-7002**

(a) In accordance with 10 U.S.C. 2410(a), any request for equitable adjustment to contract terms that exceeds the simplified acquisition threshold shall bear, at the time of submission, the following certificate executed by an individual authorized to certify the request on behalf of the Contractor:

I certify that the request is made in good faith, and that the supporting data are accurate and complete to the best of my knowledge and belief.

\_\_\_\_\_  
(Official's Name)

\_\_\_\_\_  
(Title)

- (b) The certification in paragraph (a) of this clause requires full disclosure of all relevant facts, including--
- (1) Cost or pricing data if required in accordance with FAR 15.804-2; and
  - (2) Actual cost data and data to support any estimated costs, even if cost or pricing data are not required.
- (c) The certification requirement in paragraph (a) of this clause does not apply to --
- (1) Requests for routine contract payments; for example, requests for payment for accepted supplies and services, routine vouchers under a cost-reimbursement type contract, or progress payment invoices; or
  - (2) Final adjustments under an incentive provision of the contract.

(d) The amount requested shall accurately reflect the contract adjustment for which the Contractor believes the Government is liable. The request shall include only costs for performing the change, and shall not include any costs that already have been reimbursed or that have been separately claimed. All indirect costs included in the request shall be properly allocable to the change in accordance with applicable acquisition regulations.

(End of clause)

#### **101.SUBCONTRACTS (FIXED-PRICE CONTRACTS) (OCT 1997) FAR 52.244-1**

(a) This clause does not apply to firm-fixed-price contracts and fixed-price contracts with economic price adjustment. However, it does apply to subcontracts resulting from unpriced modifications to such contracts.

(b) "Subcontract," as used in this clause, includes but is not limited to purchase orders, and changes and modifications to purchase orders. The Contractor shall notify the Contracting Officer reasonably in advance of entering into any subcontract if the Contractor does not have an approved purchasing system and if the subcontract--

(1) Is proposed to exceed \$100,000; or

(2) Is one of a number of subcontracts with a single subcontractor, under this contract, for the same or related supplies or services, that in the aggregate are expected to exceed \$100,000.

(c) The advance notification required by paragraph (b) above shall include--

(1) A description of the supplies or services to be subcontracted;

(2) Identification of the type of subcontract to be used;

(3) Identification of the proposed subcontractor and an explanation of why and how the proposed subcontractor was selected, including the competition obtained;

(4) The proposed subcontract price and the Contractor's cost or price analysis;

(5) The subcontractor's current, complete, and accurate cost or pricing data and Certificate of Current Cost or Pricing Data, if required by other contract provisions;

(6) The subcontractor's Disclosure Statement or Certificate relating to Cost Accounting Standards when such data are required by other provisions of this contract; and

(7) A negotiation memorandum reflecting--

(i) The principal elements of the subcontract price negotiations;

(ii) The most significant considerations controlling establishment of initial or revised prices;

(iii) The reason cost or pricing data were or were not required;

(iv) The extent, if any, to which the Contractor did not rely on the subcontractor's cost or pricing data in determining the price objective and in negotiating the final price;

(v) The extent, if any, to which it was recognized in the negotiation that the subcontractor's cost or pricing data were not accurate, complete, or current; the action taken by the Contractor and subcontractor; and the effect of any such defective data on the total price negotiated;

(vi) The reasons for any significant difference between the Contractor's price objective and the price negotiated; and

(vii) A complete explanation of the incentive fee or profit plan when incentives are used. The explanation shall identify each critical performance element, management decisions used to quantify each incentive element, reasons for the incentives, and a summary of all trade-off possibilities considered.

(d) The Contractor shall obtain the Contracting Officer's written consent before placing any subcontract for which advance notification is required under paragraph (b) above. However, the Contracting Officer may ratify in writing any such subcontract. Ratification shall constitute the consent of the Contracting Officer.

(e) Even if the Contractor's purchasing system has been approved, the Contractor shall obtain the Contracting Officer's written consent before placing subcontracts identified below:

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(f) Unless the consent or approval specifically provides otherwise, neither consent by the Contracting Officer to any subcontract nor approval of the Contractor's purchasing system shall constitute a determination (1) of the acceptability of any subcontract terms or conditions, (2) of the acceptability of any subcontract price or of any amount paid under any subcontract, or (3) to relieve the Contractor of any responsibility for performing this contract.

(g) No subcontract placed under this contract shall provide for payment on a cost-plus-a-percentage-of-cost basis, and any fee payable under cost-reimbursement subcontracts shall not exceed the fee limitations in subsection 15.404(c)(4)(i) of the Federal Acquisition Regulation (FAR).

(h) The Government reserves the right to review the Contractor's purchasing system as set forth in FAR Subpart 44.3  
(End of clause)

## **102. GOVERNMENT PROPERTY (FIXED-PRICE CONTRACTS) (DEC 1989) FAR 52.245-2**

*NOTE: This clause applies only when the acquisition cost of all Government-furnished property to be involved in the contract is more than \$100,000.*

(a) *Government-furnished property.* (1) The Government shall deliver to the Contractor, for use in connection with and under the terms of this contract, the Government-furnished property described in the Schedule or specifications together with any related data and information that the Contractor may request and is reasonably required for the intended use of the property (hereinafter referred to as "Government-furnished property").

(2) The delivery or performance dates for this contract are based upon the expectation that Government-furnished property suitable for use (except for property furnished "as is") will be delivered to the Contractor at the times stated in the Schedule or, if not so stated, in sufficient time to enable the Contractor to meet the contract's delivery or performance dates.

(3) If Government-furnished property is received by the Contractor in a condition not suitable for the intended use, the Contractor shall, upon receipt of it, notify the Contracting Officer, detailing the facts, and, as directed by the Contracting Officer and at Government expense, either repair, modify, return, or otherwise dispose of the property. After completing the directed action and upon written request of the Contractor, the Contracting Officer shall make an equitable adjustment as provided in paragraph (h) of this clause.

(4) If Government-furnished property is not delivered to the Contractor by the required time, the Contracting Officer shall, upon the Contractor's timely written request, make a determination of the delay, if any, caused the Contractor and shall make an equitable adjustment in accordance with paragraph (h) of this clause.

(b) *Changes in Government-furnished property.* (1) The Contracting Officer may, by written notice, (i) decrease the Government-furnished property provided or to be provided under this contract, or (ii) substitute other Government-furnished property for the property to be provided by the Government, or to be acquired by the Contractor for the Government, under this contract. The Contractor shall promptly take such action as the Contracting Officer may direct regarding the removal, shipment, or disposal of the property covered by such notice.

(2) Upon the Contractor's written request, the Contracting Officer shall make an equitable adjustment to the contract in accordance with paragraph (h) of this clause, if the Government has agreed in the Schedule to make the property available for performing this contract and there is any--

(i) Decrease or substitution in this property pursuant to subparagraph (b)(1) above; or

(ii) Withdrawal of authority to use this property, if provided under any other contract or lease.

(c) *Title in Government property.* (1) The Government shall retain title to all Government-furnished property.

(2) All Government-furnished property and all property acquired by the Contractor, title to which vests in the Government under this paragraph (collectively referred to as "Government property"), are subject to the provisions of this clause. However, special tooling accountable to this contract is subject to the provisions of the Special Tooling clause and is not subject to the provisions of this clause. Title to Government property shall not be affected by its incorporation into or attachment to any property not owned by the Government, nor shall Government property become a fixture or lose its identity as personal property by being attached to any real property.

(3) Title to each item of facilities and special test equipment acquired by the Contractor for the Government under this contract shall pass to and vest in the Government when its use in performing this contract commences or when the Government has paid for it, whichever is earlier, whether or not title previously vested in the Government.

(4) If this contract contains a provision directing the Contractor to purchase material for which the Government will reimburse the Contractor as a direct item of cost under this contract--

(i) Title to material purchased from a vendor shall pass to and vest in the Government upon the vendor's delivery of such material; and

(ii) Title to all other material shall pass to and vest in the Government upon--

(A) Issuance of the material for use in contract performance;

(B) Commencement of processing of the material or its use in contract performance; or

(C) Reimbursement of the cost of the material by the Government, whichever occurs first.



(d) *Use of Government property.* The Government property shall be used only for performing this contract, unless otherwise provided in the contract or approved by the Contracting Officer.

(e) *Property administration.* (1) The Contractor shall be responsible and accountable for all Government property provided under this contract and shall comply with Federal Acquisition Regulation (FAR) Subpart 45.5, as in effect on the date of this contract.

(2) The Contractor shall establish and maintain a program for the use, maintenance, repair, protection, and preservation of Government property in accordance with sound industrial practice and the applicable provisions of Subpart 45.5 of the FAR.

(3) If damage occurs to Government property, the risk of which has been assumed by the Government under this contract, the Government shall replace the items or the Contractor shall make such repairs as the Government directs. However, if the Contractor cannot effect such repairs with the time required, the Contractor shall dispose of the property as directed by the Contracting Officer. When any property for which the Government is responsible is replaced or repaired, the Contracting Officer shall make an equitable adjustment in accordance with paragraph (h) of this clause.

(4) The Contractor represents that the contract price does not include any amount for repairs or replacement for which the Government is responsible. Repairs or replacement of property for which the Contractor is responsible shall be accomplished by the Contractor at its own expense.

(f) *Access.* The Government and all its designees shall have access at all reasonable times to the premises in which any Government property is located for the purpose of inspecting the Government property.

(g) *Risk of loss.* Unless otherwise provided in this contract, the Contractor assumes the risk of, and shall be responsible for, any loss or destruction of, or damage to, Government property upon its delivery to the Contractor or upon passage of title to the Government under paragraph (c) of this clause. However, the Contractor is not responsible for reasonable wear and tear to Government property or for Government property properly consumed in performing this contract.

(h) *Equitable adjustment.* When this clause specifies an equitable adjustment, it shall be made to any affected contract provision in accordance with the procedures of the Changes clause. When appropriate, the Contracting Officer may initiate an equitable adjustment in favor of the Government. The right to an equitable adjustment shall be the Contractor's exclusive remedy. The Government shall not be liable to suite for breach of contract for--

- (1) Any delay in delivery of Government-furnished property;
- (2) Delivery of Government-furnished property in a condition not suitable for its intended use;
- (3) A decrease in or substitution of Government-furnished property; or
- (4) Failure to repair or replace Government property for which the Government is responsible.

(i) *Final accounting and disposition of Government property* Upon completing this contract, or at such earlier dates as may be fixed by the Contracting Officer, the Contractor shall submit, in a form acceptable to the Contracting Officer, inventory schedules covering all items of Government property (including any resulting scrap) not consumed in performing this contract or delivered to the Government. The Contractor shall prepare for shipment, delivery f.o.b. origin, or dispose of the Government property as may be directed or authorized by the Contracting Officer. The net proceeds of any such disposal shall be credited to the contract price or shall be paid to the Government as the Contracting Officer directs.

(j) *Abandonment and restoration of Contractor's premises.* Unless otherwise provided herein, the Government--

(1) May abandon any Government property in place, at which time all obligations of the Government regarding such abandoned property shall cease; and

(2) Has no obligation to restore or rehabilitate the Contractor's premises under any circumstances (e.g., abandonment, disposition upon completion of need, or upon contract completion). However, if the Government-furnished property (listed in the Schedule or specifications) is withdrawn or is unsuitable for the intended use, or if other Government property is substituted, then the equitable adjustment under paragraph (h) of this clause may properly include restoration or rehabilitation costs.

(k) *Communications.* All communications under this clause shall be in writing.

(l) *Overseas contracts.* If this contract is to be performed outside of the United States of America, its territories, or possessions, the words "Government" and "Government-furnished" (wherever they appear in this clause) shall be construed as "United States Government" and "United States Government-furnished," respectively.

(End of clause)

### **103. GOVERNMENT-FURNISHED PROPERTY (SHORT FORM) (APR 1984) FAR 52.245-4**

*NOTE: This clause applies only when the acquisition cost of all Government-furnished property to be involved in the contract is \$100,000 or less.*

(a) The Government shall delivery to the Contractor, at the time and locations stated in this contract, the Government-furnished property described in the Schedule or specifications. If that property, suitable for its intended used, is not delivered to the Contractor, the Contracting Officer shall equitably adjust affected provisions of this contract in accordance with the Changes clause when--

- (1) The Contractor submits a timely written request for an equitable adjustment; and
- (2) The facts warrant an equitable adjustment.

(b) Title to Government-furnished property shall remain in the Government. The Contractor shall use the Government-furnished property only in connection with this contract. The Contractor shall maintain adequate property control records in accordance with sound industrial practice and will make such records available for Government inspection at all reasonable times, unless the clause at Federal Acquisition Regulation 52.245-1, Property Records, is included in this contract.

(c) Upon delivery of Government-furnished property to the Contractor, the Contractor assumes, the risk and responsibility for its loss or damage, except--

- (1) For reasonable wear and tear;
- (2) To the extent property is consumed in performing this contract; or
- (3) As otherwise provided for by the provisions of this contract.

(d) Upon completing this contract, the Contractor shall follow the instructions of the Contracting Officer regarding the disposition of all Government-furnished property not consumed in performing this contract or previously delivered to the Government. The Contractor shall prepare for shipment, delivery f.o.b. origin, or dispose of the Government property, as may be directed or authorized by the Contracting Officer. The net proceeds of any such disposal shall be credited to the contract price or shall be paid to the Government as directed by the Contracting Officer.

(e) If this contract is to be performed outside the United States of America, its territories, or possessions, the words "Government" and "Government-furnished" (wherever they appear in this clause) shall be construed as "United States Government" and "United States Government-furnished," respectively.

(End of clause)

#### **104. REPORTS OF GOVERNMENT PROPERTY (MAY 1994) DFARS 252.245-7001**

(a) The Contractor shall provide an annual report--

- (1) For all DoD property for which the Contractor is accountable under the contract;
- (2) Prepared in accordance with the requirements of DD Form 1662, DoD Property in the Custody of Contractors, or approved substitute, including instructions on the reverse side of the form;
- (3) In duplicate, to the cognizant Government property administrator, no later than October 31.

(b) The Contractor is responsible for reporting all Government property accountable to this contract, including that at subcontractor and alternate locations.

(End of clause)

#### **105. INSPECTION OF CONSTRUCTION (AUG 1996) FAR 52.246-12**

(a) *Definition.* "Work" includes, but is not limited to, materials, workmanship, and manufacture and fabrication of components.

(b) The Contractor shall maintain an adequate inspection system and perform such inspections as will ensure that the work performed under the contract conforms to contract requirements. The Contractor shall maintain complete inspection records and make them available to the Government. All work shall be conducted under the general direction of the Contracting Officer and is subject to Government inspection and test at all places and at all reasonable times before acceptance to ensure strict compliance with the terms of the contract.

(c) Government inspections and tests are for the sole benefit of the Government and do not--

- (1) Relieve the Contractor of responsibility for providing adequate quality control measures;
- (2) Relieve the Contractor of responsibility for damage to or loss of the material before acceptance;
- (3) Constitute or imply acceptance; or
- (4) Affect the continuing rights of the Government after acceptance of the complete work under paragraph (i)

below.

(d) The presence or absence of a Government inspector does not relieve the Contractor from any contract requirement, nor is the inspector authorized to change any term or condition of the specification without the Contracting Officer's written authorization.

(e) The Contractor shall promptly furnish, at no increase in contract price, all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by the Contracting Officer. The Government may charge to the Contractor any additional cost of inspection or test when work is not ready at the time specified by the Contractor for inspection or test, or when prior rejection makes reinspection or retest necessary. The Government shall perform all inspections and tests in a manner that will not unnecessarily delay the work. Special, full size, and performance tests shall be performed as described in the contract.

(f) The Contractor shall, without charge, replace or correct work found by the Government not to conform to contract requirements, unless in the public interest the Government consents to accept the work with an appropriate adjustment in contract price. The Contractor shall promptly segregate and remove rejected material from the premises.

(g) If the Contractor does not promptly replace or correct rejected work, the Government may (1) by contract or otherwise, replace or correct the work and charge the cost to the Contractor or (2) terminate for default the Contractor's right to proceed.

(h) If, before acceptance of the entire work, the Government decides to examine already completed work by removing it or tearing it out, the Contractor, on request, shall promptly furnish all necessary facilities, labor, and material. If the work is found to be defective or nonconforming in any material respect due to the fault of the Contractor or its subcontractors, the Contractor shall defray the expenses of the examination and of satisfactory reconstruction. However, if the work is found to meet contract requirements, the Contracting Officer shall make an equitable adjustment for the additional services involved in the examination and reconstruction, including, if completion of the work was thereby delayed, an extension of time.

(i) Unless otherwise specified in the contract, the Government shall accept, as promptly as practicable after completion and inspection, all work required by the contract or that portion of the work the Contracting Officer determines can be accepted separately. Acceptance shall be final and conclusive except for latent defects, fraud, gross mistakes amounting to fraud, or the Government's rights under any warranty or guarantee.

(End of clause)

#### **106. VALUE ENGINEERING--CONSTRUCTION (MAR 1989)--ALTERNATE I (APR 1984) FAR 52.248-3 I**

(a) *General.* The Contractor is encouraged to develop, prepare, and submit value engineering change proposals (VECP's) voluntarily. The Contractor shall share in any instant contract savings realized from accepted VECP's, in accordance with paragraph (f) below.

(b) *Definitions.* "Collateral costs," as used in this clause, means agency costs of operation, maintenance, logistic support, or Government-furnished property.

"Collateral savings," as used in this clause, means those measurable net reductions resulting from a VECP in the agency's overall projected collateral costs, exclusive of acquisition savings, whether or not the acquisition cost changes.

"Contractor's development and implementation costs," as used in this clause, means those costs the Contractor incurs on a VECP specifically in developing, testing, preparing, and submitting the VECP, as well as those costs the Contractor incurs to make the contractual changes required by Government acceptance of a VECP.

"Government costs," as used in this clause means those agency costs that result directly from developing and implementing the VECP, such as any net increases in the cost of testing, operations, maintenance, and logistic support. The term does not include the normal administrative costs of processing the VECP.

"Instant contract savings," as used in this clause, means the estimated reduction in Contractor cost of performance resulting from acceptance of the VECP, minus allowable Contractor's development and implementation costs, including subcontractors' development and implementation costs (see paragraph (h) below).

"Value engineering change proposal (VECP): means a proposal that--

- (1) Requires a change to this, the instant contract, to implement; and
- (2) Results in reducing the contract price or estimated cost without impairing essential functions or characteristics; *provided*, that it does not involve a change--
  - (i) In deliverable end item quantities only; or
  - (ii) To the contract type only.

(c) *VECP preparation.* As a minimum, the Contractor shall include in each VECP the information described in subparagraphs (1) through (7) below. If the proposed change is affected by contractually required configuration management or similar procedures, the instructions in those procedures relating to format, identification, and priority assignment shall govern VECP preparation. The VECP shall include the following:

(1) A description of the difference between the existing contract requirement and that proposed, the comparative advantages and disadvantages of each, a justification when an item's function or characteristics are being altered, and the effect of the change on the end item's performance.

(2) A list and analysis of the contract requirements that must be changed if the VECP is accepted, including any suggested specification revisions.

(3) A separate, detailed cost estimate for (i) the affected portions of the existing contract requirement and (ii) the VECP. The cost reduction associated with the VECP shall take into account the Contractor's allowable development and implementation costs, including any amount attributable to subcontracts under paragraph (h) below.

(4) A description and estimate of costs the Government may incur in implementing the VECP, such as test and evaluation and operating and support costs.

(5) A predicting of any effects the proposed change would have on collateral costs to the agency.

(6) A statement of the time by which a contract modification accepting the VECP must be issued in order to achieve the maximum cost reduction, noting any effect on the contract completion time or delivery schedule.

(7) Identification of any previous submissions of the VECP, including the dates submitted, the agencies and contract numbers involved, and previous Government actions, if known.

(d) *Submission.* The Contractor shall submit VECP's to the Resident Engineer at the worksite, with a copy to the Contracting Officer.

(e) *Government action.* (1) The Contracting Officer shall notify the Contractor of the status of the VECP within 45 calendar days after the contracting office receives it. If additional time is required, the Contracting Officer shall notify the Contractor within the 45-day period and provide the reason for the delay and the expected date of the decisions. The Government will process VECP's expeditiously; however, it shall not be liable for any delay in acting upon a VECP.

(2) If the VECP is not accepted, the Contracting Officer shall notify the Contractor in writing, explaining the reasons for rejection. The Contractor may withdraw any VECP, in whole or in part, at any time before it is accepted by the Government. The Contracting Officer may require that the Contractor provide written notification before undertaking significant expenditures for VECP effort.

(3) Any VECP may be accepted, in whole or in part, by the Contracting Officer's award of a modification to this contract citing this clause. The Contracting Officer may accept the VECP, even though an agreement on price reduction has not been reached, by issuing the Contractor a notice to proceed with the change. Until a notice to proceed is issued or a contract modification applies a VECP to this contract, the Contractor shall perform in accordance with the existing contract. The Contracting Officer's decision to accept or reject all or part of any VECP shall be final and not subject to the Disputes clause or otherwise subject to litigation under the Contract Disputes Act of 1978 (41 U.S.C. 601-613).

(f) *Sharing.* (1) *Rates.* The Government's share of savings is determined by subtracting Government costs from instant contract savings and multiplying the result by (i) 45 percent for fixed-price contracts or (ii) 75 percent for cost-reimbursement contracts.

(2) *Payment.* Payment of any share due the Contractor for use of a VECP on this contract shall be authorized by a modification to this contract to--

(i) Accept the VECP;

(ii) Reduce the contract price or estimated cost by the amount of instant contract savings; and

(iii) Provide the Contractor's share of savings by adding the amount calculated to the contract price or fee.

(g) *Subcontracts.* The Contractor shall include an appropriate value engineering clause in any subcontract of \$50,000 or more and may include one in subcontracts of lesser value. In computing any adjustment in this contract's price under paragraph (f) above, the Contractor's allowable development and implementation costs shall include any subcontractor's allowable development and implementation costs clearly resulting from a VECP accepted by the Government under this contract, but shall exclude any value engineering incentive payments to a subcontractor. The Contractor may choose any arrangement for subcontractor value engineering incentive payments; *provided*, that these payments shall not reduce the Government's share of the savings resulting from the VECP.

(h) *Data.* The Contractor may restrict the Government's right to use any part of a VECP or the supporting data by marking the following legend on the affected parts:

"These data, furnished under the Value Engineering--Construction clause of contract \_\_\_\_\_, shall not be disclosed outside the Government or duplicated, used, or disclosed, in whole or in part, for any purpose other than to evaluate a value engineering change proposal submitted under the clause. This restriction does not limit the Government's right to use information contained in these data if it has been obtained or is otherwise available from the Contractor or from another source without limitations."

If a VECP is accepted, the Contractor hereby grants the Government unlimited rights in the VECP and supporting data, except that, with respect to data qualifying and submitted as limited rights technical data, the Government shall have the rights specified in the contract modification implementing the VECP and shall appropriately mark the data. (The terms "unlimited rights" and "limited rights" are defined in Part 27 of the Federal Acquisition Regulation.)

(End of clause)

**107. TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (FIXED-PRICE)  
(SEP 1996)--ALTERNATE I (SEP 1996) FAR 52.249-2 I**

(a) The Government may terminate performance of the work under this contract in whole or in part if the Contracting Officer determines that a termination is in the Government's interest. The Contracting Officer shall terminate by delivering to the Contractor a Notice of Termination specifying the extent of termination and the effective date.

(b) After receipt of a Notice of Termination and except as directed by the Contracting Officer, the Contractor shall immediately proceed with the following obligations, regardless of any delay in determining or adjusting any amounts due under this clause:

- (1) Stop work as specified in the notice.
  - (2) Place no further subcontracts or orders (referred to as subcontracts in this clause) for materials, services, or facilities, except as necessary to complete the continued portion of the contract.
  - (3) Terminate all subcontracts to the extent they relate to the work terminated.
  - (4) Assign to the Government, as directed by the Contracting Officer, all right, title, and interest of the Contractor under the subcontracts terminated, in which case the Government shall have the right to settle or to pay any termination settlement proposal arising out of those terminations.
  - (5) With approval or ratification to the extent required by the Contracting Officer, settle all outstanding liabilities and termination settlement proposals arising from the termination settlement proposals arising from the termination of subcontracts; the approval or ratification will be final for purposes of this clause.
  - (6) As directed by the Contracting Officer, transfer title and delivery to the Government (i) the fabricated or unfabricated parts, work in process, completed work, supplies, and other material produced or acquired for the work terminated, and (ii) the completed or partially completed plans, drawings, information, and other property that, if the contract had been completed, would be required to be furnished to the Government.
  - (7) Complete performance of the work not terminated.
  - (8) Take any action that may be necessary, or that the Contracting Officer may direct, for the protection and preservation of the property related to this contract that is in the possession of the Contractor and in which the Government has or may acquire an interest.
  - (9) Use its best efforts to sell, as directed or authorized by the Contracting Officer, any property of the types referred to in subparagraph (b)(6) of this clause; *provided*, however, that the Contractor (i) is not required to extend credit to any purchaser and (ii) may acquire the property under the conditions prescribed by, and at prices approved by, the Contracting Officer. The proceeds of any transfer or disposition will be applied to reduce any payments to be made by the Government under this contract, credited to the price or cost of the work, or paid in any other manner directed by the Contracting Officer.
- (c) The Contractor shall submit complete termination inventory schedules no later than 120 days from the effective date of termination, unless extended in writing by the Contracting Officer upon written request of the Contractor within this 120-day period.
- (d) After expiration of the plant clearance period as defined in Subpart 45.6 of the Federal Acquisition Regulation, the Contractor may submit to the Contracting Officer a list, certified as to quantity and quality, of termination inventory not previously disposed of, excluding items authorized for disposition by the Contracting Officer. The Contractor may request the Government to remove those items or enter into an agreement for their storage. Within 15 days, the Government will accept title to those items and remove them or enter into a storage agreement. The Contracting Officer may verify the list upon removal of the items, or if stored, within 45 days from submission of the list, and shall correct the list, as necessary, before final settlement.
- (e) After termination, the Contractor shall submit a final termination settlement proposal to the Contracting Officer in the form and with the certification prescribed by the Contracting Officer. The Contractor shall submit the proposal promptly, but no later than 1 year from the effective date of termination, unless extended in writing by the Contracting Officer upon written request of the Contractor within this 1-year period. However, if the Contracting Officer determines that the facts justify it, a termination settlement proposal may be received and acted on after 1 year or any extension. If the Contractor fails to submit the proposal within the time allowed, the Contracting Officer may determine, on the basis of

information available, the amount, if any due the Contractor because of the termination and shall pay the amount determined.

(f) Subject to paragraph (e) of this clause, the Contractor and the Contracting Officer may agree upon the whole or any part of the amount to be paid because of the termination. The amount may include a reasonable allowance for profit on work done. However, the agreed amount, whether under this paragraph (f) or paragraph (g) of this clause, exclusive of costs shown in subparagraph (g)(3) of this clause, may not exceed the total contract price as reduced by (1) the amount of payments previously made and (2) the contract price of work not terminated. The contract shall be modified, and the Contractor paid the agreed amount. Paragraph (g) of this clause shall not limit, restrict, or affect the amount that may be agreed upon to be paid under this paragraph.

(g) If the Contractor and the Contracting Officer fail to agree on the whole amount to be paid because of the termination of work, the Contracting Officer shall pay the Contractor the amounts determined as follows, but without duplication of any amounts agreed upon under paragraph (f) of this clause:

(1) For contract work performed before the effective date of termination, the total (without duplication of any items) of--

(i) The cost of this work;

(ii) The cost of settling and paying termination settlement proposals under terminated subcontracts that are properly chargeable to the terminated portion of the contract if not included in subdivision (g)(1)(i) of this clause; and

(iii) A sum, as profit on subdivision (g)(1)(i) of this clause, determined by the Contracting Officer under 49.202 of the Federal Acquisition Regulation, in effect on the date of this contract, to be fair and reasonable; however, if it appears that the Contractor would have sustained a loss on the entire contract had it been completed, the Contracting Officer shall allow no profit under this subdivision (iii) and shall reduce the settlement to reflect the indicated rate of loss.

(2) The reasonable costs of settlement of the work terminated, including--

(i) Accounting, legal, clerical, and other expenses reasonably necessary for the preparation of termination settlement proposals and supporting data;

(ii) The termination and settlement of subcontracts (excluding the amounts of such settlements); and

(iii) Storage, transportation, and other costs incurred, reasonably necessary for the preservation, protection, or disposition of the termination inventory.

(h) Except for normal spoilage, and except to the extent that the Government expressly assumed the risk of loss, the Contracting Officer shall exclude from the amounts payable to the Contractor under paragraph (g) of this clause, the fair value, as determined by the Contracting Officer, of property that is destroyed, lost, stolen, or damaged so as to become undeliverable to the Government or to a buyer.

(i) The cost principles and procedures of Part 31 of the Federal Acquisition Regulation, in effect on the date of this contract, shall govern all costs claimed, agreed to, or determined under this clause.

(j) The Contractor shall have the right of appeal, under the Disputes clause, from any determination made by the Contracting Officer under paragraph (e), (g), or (l) of this clause, except that if the Contractor failed to submit the termination settlement proposal or request for equitable adjustment within the time provided in paragraph (e) or (l), respectively, and failed to request a time extension, there is not right of appeal.

(k) In arriving at the amount due the Contractor under this clause, there shall be deducted--

(1) All unliquidated advance or other payments to the Contractor under the terminated portion of this contract;

(2) Any claim which the Government has against the Contractor under this contract; and

(3) The agreed price for, or the proceeds of sale of, materials, supplies, or other things acquired by the Contractor or sold under the provisions of this clause and not recovered by or credited to the Government.

(l) If the termination is partial, the Contractor may file a proposal with the Contracting Officer for an equitable adjustment of the price(s) of the continued portion of the contract. The Contracting Officer shall make any equitable adjustment agreed upon. Any proposal by the Contractor for an equitable adjustment under this clause shall be requested within 90 days from the effective date of termination unless extended in writing by the Contracting Officer.

(m)(1) The Government may, under the terms and conditions it prescribes, make partial payments and payments against costs incurred by the Contractor for the terminated portion of the contract, if the Contracting Officer believes the total of these payments will not exceed the amount to which the Contractor will be entitled.

(2) If the total payments exceed the amount finally determined to be due, the Contractor shall repay the excess to the Government upon demand, together with interest computed at the rate established by the Secretary of the Treasury under 50 U.S.C. App. 1215(b)(2). Interest shall be computed for the period from the date the excess payment is received by the Contractor to the date the excess is repaid. Interest shall not be charged on any excess payment due to a reduction in the Contractor's termination settlement proposal because of retention or other disposition of termination inventory until 10 days after the date of the retention or disposition, or a later date determined by the Contracting Officer because of the circumstances.

(n) Unless otherwise provided in this contract or by statute, the Contractor shall maintain all records and documents relating to the terminated portion of this contract for 3 years after final settlement. This includes all books and other evidence bearing on the Contractor's costs and expenses under this contract. The Contractor shall make these records and documents available to the Government, at the Contractor's office, at all reasonable times, without any direct charge. If approved by the Contracting Officer, photographs, microphotographs, or other authentic reproductions may be maintained instead of original records and documents.

(End of clause)

#### **108. DEFAULT (FIXED-PRICE CONSTRUCTION) (APR 1984) FAR 52.249-10**

(a) If the Contractor refuses or fails to prosecute the work or any separable part, with the diligence that will insure its completion within the time specified in this contract including any extension, or fails to complete the work within this time, the Government may, by written notice to the Contractor, terminate the right to proceed with the work (or the separable part of the work) that has been delayed. In this event, the government may take over the work and complete it by contract or otherwise, and may take possession of and use any materials, appliances, and plant on the work site necessary for completing the work. The Contractor and its sureties shall be liable for any damage to the Government resulting from the Contractor's refusal or failure to complete the work within the specified time, whether or not the Contractor's right to proceed with the work is terminated. This liability includes any increased costs incurred by the Government in completing the work.

(b) The Contractor's right to proceed shall not be terminated nor the Contractor charged with damages under this clause, if--

(1) The delay in completing the work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor. Examples of such causes include (i) acts of God or of the public enemy, (ii) acts of the Government in either its sovereign or contractual capacity, (iii) acts of another Contractor in the performance of a contract with the Government, (iv) fires, (v) floods, (vi) epidemics, (vii) quarantine restrictions, (viii) strikes, (ix) freight embargoes, (x) unusually severe weather, or (xi) delays of subcontractors or suppliers at any tier arising from unforeseeable causes beyond the control and without the fault or negligence of both the Contractor and the subcontractors or suppliers; and

(2) The Contractor, within 10 days from the beginning of any delay (unless extended by the Contracting Officer), notifies the Contracting Officer in writing of the causes of delay. The Contracting Officer shall ascertain the facts and the extent of delay. If, in the judgment of the Contracting Officer, the findings of fact warrant such action, the time for completing the work shall be extended. The findings of the Contracting Officer shall be final and conclusive on the parties, but subject to appeal under the Disputes clause.

(c) If, after termination of the Contractor's right to proceed, it is determined that the Contractor was not in default, or that the delay was excusable, the rights and obligations of the parties will be the same as if the termination had been issued for the convenience of the Government.

(d) The rights and remedies of the Government in this clause are in addition to any other rights and remedies provided by law or under this contract.

(End of clause)

#### **109. COMPUTER GENERATED FORMS (JAN 1991) FAR 52.253-1**

(a) Any data required to be submitted on a Standard or Optional Form prescribed by the Federal Acquisition Regulation (FAR) may be submitted on a computer generated version of the form, *provided* the form carries the Standard or Optional Form number and edition data.

(b) Unless prohibited by agency regulations, any data required to be submitted on an agency unique form prescribed by an agency supplement to the FAR may be submitted on a computer generated version of the form provided there is no change to the name, content, or sequence of the data elements on the form and provided the form carries the agency form number and edition data.

(c) If the Contractor submits a computer generated version of a form that is different than the required form, then the rights and obligations of the parties will be determined based on the content of the required form.

(End of clause)

END OF SECTION 00700

SECTION 00800

SPECIAL CONTRACT REQUIREMENTS

2 January 1996

1. COMMENCEMENT, PROSECUTION AND COMPLETION OF WORK (APR 1984) FAR 52.211-10. The Contractor shall be required to commence work under this contract within 10 calendar days after the date the Contractor receives the notice to proceed, prosecute said work diligently, and complete the entire work ready for use not later than 720 calendar days after date of receipt of notice to proceed. The time stated for completion shall include as-built drawings, O&M manuals, operational tests/reports/training/instructions, equipment lists, and final cleanup of the premises.

2 January 1996

2. LIQUIDATED DAMAGES--CONSTRUCTION (APR 1984) FAR 52.211-12.

2.1 If the Contractor fails to complete the work within the time specified in the contract, or any extension, the Contractor shall pay to the Government as liquidated damages, the sum of \$820.00 for each day of delay.

2.2 If the Government terminates the Contractor's right to proceed, the resulting damage will consist of liquidated damages until such reasonable time as may be required for final completion of the work together with any increased costs occasioned the Government in completing the work.

2.3 If the Government does not terminate the Contractor's right to proceed, the resulting damage will consist of liquidated damages until the work is completed or accepted.

3. thru 5. NOT USED.

1 August 1996

(2) 6. CONTRACT DRAWINGS, MAPS AND SPECIFICATIONS (DEC 1991) DFARS 252.236-7001.

6.1 The Government--

Will provide the Contractor ,without charge, one set of large-scale reproducible contract drawings.

6.2 The Contractor shall--

(1) Check all drawings furnished immediately upon receipt;

(2) Compare all drawings and verify the figures before laying out the work;

(3) Promptly notify the Contracting Officer of any discrepancies; and

(4) Be responsible for any errors which might have been avoided by complying with paragraph 6.2 (1), (2) and (3).

6.3 Omissions from the drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the work, but shall be performed as if fully and correctly set forth and described in the drawings and specifications.



6.4 The work shall conform to the specifications and the contract drawings identified on the following index of drawings:

19 October 1998  
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Drawing Code F 214-10-13

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7. NOT USED.

17 JULY 1992

8. RIGHTS IN SHOP DRAWINGS (APR 1966) DFARS 252.227-7033.

8.1 Shop drawings for construction means drawings, submitted to the Government by the Construction Contractor, subcontractor or any lower tier subcontractor pursuant to a construction contract, showing detail (i) the proposed fabrication and assembly of structural elements and (ii) the installation (i.e., form, fit, and attachment details) of materials or equipment. The Government may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.

8.2 This clause, including this paragraph (8.2), shall be included in all subcontracts hereunder at any tier.

2 Feb 1998

9. AS-BUILT DRAWINGS.

9.1 Payment for As-Built Drawings. During the progress of the job, the Contractor shall keep a careful record at the jobsite of all as-built conditions which differ from the contract drawings. The Contractor shall enter such as-built conditions on as-built drawings promptly but in no case later than on a weekly basis. If the Contractor fails to maintain the as-built drawings as required herein, the Contracting Officer will deduct from the monthly progress payment, an amount representing the estimated monthly cost of maintaining the as-built drawings. Final payment with respect to separately priced facilities or the contract as a whole, will be withheld until proper as-built drawings have been furnished to and accepted by the Contracting Officer.

9.2 Maintenance of As-Built Drawings. All as-built conditions which differ from the contract drawings, will be maintained in red on a master set of contract drawings suitable for reproducing. The Contractor shall provide to the Government this master set of as-built drawings six (6) weeks prior to occupancy of the facilities by the Government. This document will be used by the Government for update of project CADD files in order to facilitate transfer of complete as-built files immediately upon occupancy by the Government. The Contractor shall retain a copy of the master, in order to continue to record any revisions which occur after submission of the master copy. Marked-up drawings shall show all as-built conditions made up to the time of the as-built submittal and shall reflect any changes, alterations adjustments or modifications resulting from approved shop drawings. An additional as-built submittal will be necessary if additional revisions occur subsequent to the first as-built submittal. All additional revisions will be shown in a different color and will be submitted to the Government as soon as final as-built conditions are known

9.3 As-Built Conditions Which Are Different From The Contract Drawings. All as-built conditions which are different from the contract drawings shall be accurately reflected on each drawing. The as-built condition may be reflected by redrawing on every sheet which is impacted or by redrawing on one sheet and referring to that redrawn sheet on all other sheets that are impacted. If the as-built condition is accurately reflected on a shop drawing, then a copy of that shop drawing may be attached to the contract drawing with the corrections noted on that shop drawing with references to all other contract drawings where the as-built condition occurs. If the as-built condition is accurately reflected in a contract modification, then a copy of the modification sketch shall be attached to the contract drawing with the corrections noted on that sketch with references to all other contract drawings where the as-built condition occurs.

9.4 Additional As-Built Information That Exceeds The Detail Shown On The Contract Drawings. These as-built conditions include those that reflect structural details, foundation layouts, equipment, sizes, mechanical room layouts and other extensions of design, that were not shown in the original contract documents because the exact details were not known until after the time of approved shop drawings. It is recognized that these shop drawing submittals (revised showing as-built conditions) will serve as the as-built record without actual incorporation into the contract drawings. All such shop drawing submittals must include, along with the hard copy of the drawings, CADD files of the shop drawings in a commercially available digital format compatible with Intergraph's RLE raster format or Bentley Microstation Version 5 or later. All shop drawings which require submittal of CADD files are indicated in the submittal register located at the end of this section.

9.5 Underground Utilities. The as-built drawings shall indicate, in addition to all changes and corrections, the actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, the as-built drawings shall show, by offset dimensions to two permanently fixed surface features, the end of each run including each change in direction. Valves, splice boxes and similar appurtenances shall be located by dimensioning along the utility run from a reference point. The average depth below the surface of each run shall also be recorded.

9.6 Borrow Areas. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, the Contractor shall furnish a contour map of the final borrow pit/spoil area elevations.

9.7 Fire Protection Systems. If fire protection and fire detection related systems are included in this project, the as-built drawings will include detailed information for all aspects of the systems including wiring, piping, and equipment drawings.

1 August 1996

(2) 10. EQUIPMENT DATA.

10.1 Real Property Equipment. The Contractor shall be required to make a list of all installed equipment furnished under this contract. This list shall include all information usually listed on manufacturer's name plate. The RMS form is called INSTALLATION PROPERTY INFORMATION can be found in the RMS software. A copy of this form can be found at the end of the SPECIAL CONTRACT REQUIREMENTS. The list shall also include the cost of each piece of installed property F.O.B. construction site. For each of the items which is specified herein to be guaranteed for a specified period from the date of acceptance thereof, the following information shall be given: The name, serial and model number address of equipment supplier, or manufacturer originating the guaranteed item. The Contractor's guarantee to the Government of these items will not be limited by the terms of any manufacturer's guarantee to the Contractor. The list shall be furnished in electronic format in addition to hard paper copy. The list shall be furnished to the Contracting Officer not later than thirty (30) calendar days prior to completion of any segment of the contract work which has an incremental completion date.

10.2 Maintenance and Parts Data. The Contractor will be required to furnish a brochure, catalog cut, parts list, manufacturer's data sheet or other publication which will show detailed parts data on all other equipment subject to repair and maintenance procedures not otherwise required in Operations and Maintenance Manuals specified elsewhere in this contract. Distribution of directives shall follow the same requirements as listed in paragraph 10.1.

2 January 1996

11. PHYSICAL DATA (APR 1984) FAR 52.236-4. Data and information furnished or referred to below are furnished for the Contractor's information. The Government will not be responsible for any interpretation or conclusion drawn from the data or information by the Contractor.

11.1 Physical Conditions indicated on the drawings and in the specifications are the result of site investigations

11.2 Weather Conditions. The Contractor shall make his own investigations as to weather conditions at the site. Data may be obtained from various National Weather Service offices located generally at airports of principal cities, the nearest to this project being:

Nashville  
NWS Office  
2500 Ambrose Dr.  
Arcola, TN 37701

Historical data for all areas may be obtained from:

U. S. Department of Commerce  
National Climatic Center  
Federal Building  
Asheville, N. C. 28801

11.3 Transportation Facilities. Roads and railroads in the general area are shown on the drawings. Access ways shall be investigated by the Contractor to satisfy himself as to their existence and allowable use.

5 June 1990

12. UTILITIES (APR 1984) FAR 52.236-14 (Para. 12.1.1 & 12.1.2 only).

12.1 Availability and Use of Utility Services.

12.1.1 The Government will make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. Unless otherwise provided in the contract, the amount of each utility service consumed shall be charged to or paid for by the Contractor at prevailing rates charged to the Government or, where the utility is produced by the Government, at reasonable rates determined by the Contracting Officer. The Contractor shall carefully conserve any utilities furnished without charge.

12.1.2 The Contractor, at its expense and in a workmanlike manner satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of each utility used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.

12.3 Interruptions of Utilities:

12.3.1 No utility services shall be interrupted by the Contractor to make connections, to relocate, or for any purpose without approval of the Contracting Officer.

12.3.2 Request for Permission to shut down services shall be submitted in writing to the Contracting Officer not less than seventeen (17) days prior to date of proposed interruption. The request shall give the following information:

- (1) Nature of Utility (Gas, L.P. or H.P., Water, etc.)
- (2) Size of line and location of shutoff.
- (3) Buildings and services affected.
- (4) Hours and date of shutoff.
- (5) Estimated length of time services will be interrupted.

12.3.3 Services shall not be shutoff until receipt of approval of the proposed hours and date from the Contracting Officer.

12.3.4 Shutoffs which will cause interruption of Government work operations as determined by the Contracting Officer shall be accomplished during regular non-work hours or on non-work days of the Using Agency without any additional cost to the Government.

12.3.5 Operation of valves on water mains will be by Government personnel. Where shutoff of water lines interrupts service to fire hydrants or fire sprinkler systems, the Contractor shall arrange his operations and have sufficient material and personnel available to complete the work without undue delay or to restore service without delay in event of emergency.

12.3.6 Flow in gas mains which have been shut off shall not be restored until the Government inspector has determined that all items serviced by the gas line have been shut off.

13. NOT USED.

15 June 1990

(1) 14. LAYOUT OF WORK (APR 1984) FAR 52.236-17. The Contractor shall lay out its work from Government-established coordinates and bench marks indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at his own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the Contracting Officer. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the Contracting Officer until authorized to remove them. If such marks are destroyed by the Contractor or through its negligence before their removal is authorized, the Contracting Officer may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.

15 June 1990

15. PERFORMANCE OF WORK BY THE CONTRACTOR (APR 1984) FAR 52.236-1 (Para. 15 only). The Contractor shall perform on the site, and with its own organization, work equivalent to at least 20 percent of the total amount of work to be performed under the contract. This percentage may be reduced by a supplemental agreement to this contract if, during performing the work, the Contractor requests a reduction and the Contracting Officer determines that the reduction would be to the advantage of the Government.

15.1 For purposes of this paragraph "WORK BY THE CONTRACTOR" is defined as prime Contractor direct contract labor (including testing and layout personnel), exclusive of other general condition or field overhead personnel, material, equipment, or subcontractors. The "TOTAL AMOUNT OF WORK" is defined as total direct contract labor (including testing and layout personnel), exclusive of other general condition or field overhead personnel, material, or equipment.

15.2 Within 7 days after the award of any subcontract, either by himself or a subcontractor, the Contractor shall deliver to the Contracting Officer a completed SF 1413, "Statement and Acknowledgment." The form shall include the subcontractor's acknowledgement of the inclusion in his subcontract of the clauses of this contract entitled "Davis-Bacon Act," "Contract Work Hours and Safety Standards Act-Overtime Compensation," "Apprentices and Trainees," "Compliance with Copeland Regulations," "Withholding of Funds," "Subcontracts," "Contract Termination-Debarment," and "Payrolls and Basic Records." Nothing contained in this contract shall create any contractual relation between the subcontractor and the Government.

16. NOT USED.

24 February 1992

17. SUPERINTENDENCE OF SUBCONTRACTORS

17.1 The Contractor shall be required to furnish the following, in addition to the superintendence required by CONTRACT CLAUSE: SUPERINTENDENCE BY THE CONTRACTOR.

(1) If more than 50 percent and less than 70 percent of the value of the contract work is subcontracted, one superintendent shall be provided at the site and on the Contractor's payroll to be responsible for coordinating, directing, inspecting and expediting the subcontract work.

(2) If 70 percent or more of the value of the work is subcontracted, the Contractor shall be required to furnish two such superintendents to be responsible for coordinating, directing, inspecting and expediting the subcontract work.

17.2 If the Contracting Officer, at any time after 50 percent of the subcontracted work has been completed, finds that satisfactory progress is

being made, he may waive all or part of the above requirements for additional superintendence subject to the right of the Contracting Officer to reinstate such requirement if at any time during the progress of the remaining work he finds that satisfactory progress is not being made.

15 June 1990

18. IDENTIFICATION OF EMPLOYEES.

18.1 The Contractor shall be responsible for furnishing an identification badge/card to each employee prior to the employees work on-site, and for requiring each employee engaged on the work to display identification as may be approved and directed by the Contracting Officer. All prescribed identification shall immediately be delivered to the Contracting Officer for cancellation upon release of the employee. When required by the Contracting Officer, the Contractor shall obtain and submit fingerprints of all persons employed or to be employed on the project.

18.2 Not Used.

24 February 1992

19. CONTRACTOR-PREPARED NETWORK ANALYSIS SYSTEM

The progress chart to be prepared by the Contractor pursuant to the clause entitled "Schedules for Construction Contracts," shall consist of a network analysis system as described below. In preparing this system the scheduling of construction is the responsibility of the Contractor. The requirement for the system is included to assure adequate planning and execution of the work and to assist the Contracting Officer in appraising the reasonableness of the proposed schedule and evaluating progress of the work.

19.1 NOT USED.

19.2 The system shall consist of diagrams and accompanying mathematical analyses. The diagrams shall show elements of the project in detail and the entire project in summary.

(1) Diagrams shall show the order and interdependence of activities and the sequence in which the work is to be accomplished as planned by the Contractor. The basic concept of a network analysis diagram will be followed to show how the start of a given activity is dependent on the completion of preceding activities and its completion restricts the start of following activities.

(2) Detailed network activities shown on a detailed or sub-network diagram shall include, in addition to construction activities, the submittal and approval of samples of materials and shop drawings, the procurement of critical materials and equipment, fabrication of special material and equipment and their installation and testing. All activities of the Government that affect progress and contract required dates for completion of all or parts of the work will be shown. The detail of information shall be such that duration times of activities will range from three (3) to thirty (30) days with not over two percent (2%) of the activities exceeding these limits. The activities which comprise the following separate buildings and features shall be separately identifiable by coding or use of sub-networks or both:

- Building B
- Building C
- Building D
- 86<sup>th</sup> Deployment Storage Building
- 626<sup>th</sup> Deployment Storage Building
- Sentry Buildings
- Earthwork
- Site Utilities
- Paving Work (Bit.)



## Hardstand (Conc.)

The selection and number of activities shall be subject to the Contracting Officer's approval. Detailed networks, when summary networks are also furnished, need not be time scaled but shall be drafted to show a continuous flow from left to right with no arrows from right to left. The following information shall be shown on the diagrams for each activity: preceding and following event numbers, description of the activity, cost, and activity duration.

(3) Summary Network. If the project is of such size that the entire network cannot be readily shown on a single sheet, a summary network diagram shall be provided. The summary network diagram shall consist of a minimum of fifty activities and a maximum of one hundred and fifty activities, and shall be based on and supported by detailed diagrams. Related activities shall be grouped on the network. The critical path shall be plotted generally along the center of the sheet with channels with increasing float placed towards the top or bottom. The summary network shall be time scaled using units of approximately one-half inch equals one week or other suitable scale approved by the Contracting Officer. Weekends and holidays shall be indicated. Where slack exists, the activities shall be shown at the time when they are scheduled to be accomplished.

(4) The mathematical analysis of the network diagram shall include a tabulation of each activity shown on the detailed network diagrams. The following information will be furnished as a minimum for each activity:

- (i) predecessor and successor activity identification (numbers shall be selected and assigned so as to permit identification of the activities with bid items);
- (ii) activity description;
- (iii) estimated duration of activities (the best estimate available at time of computation);
- (iv) earliest start date (by calendar date);
- (v) earliest finish date (by calendar date);
- (vi) scheduled or actual start date (by calendar date);
- (vii) scheduled or actual finish date (by calendar date);
- (viii) latest start date (by calendar date);
- (ix) latest finish date (by calendar date);
- (x) slack or float;
- (xi) monetary value of activity;
- (xii) responsibility for activity (Prime Contractor, subcontractors, suppliers, Government, etc.);
- (xiii) manpower required;
- (xiv) percentage of activity completed;
- (xv) Contractor's earnings based on portion of activity completed; and
- (xvi) bid items of which activity is a part.

(5) The program or means used in making the mathematical computation shall be capable of compiling the total value of completed and partially completed activities and subtotals from separate buildings or feature listed in paragraph 19.2(2).

(6) In addition to the tabulation of activities, the computation will include the following data:

(i) identification of activities which are planned to be expedited by use of overtime or double shifts to be worked including Saturdays, Sundays and holidays;

(ii) on-site manpower loading schedule;

(iii) a description of the major items of construction equipment planned for operations of the project. (The description shall include the

type, number of units and unit capacities. A schedule showing proposed time equipment will be on the job keyed to activities on which equipment will be used shall be provided); and

(iv) where portions of the work are to be paid by unit costs, the estimated number of units in an activity which was used in developing the total activity cost.

(7) The analysis shall list the activities in sorts or groups as follows:

(i) by the preceding event number from lowest to highest and then in the order of the following event number;

(ii) by the amount of slack, then in order of preceding event number;

(iii) by responsibility in order of earliest allowable start dates; and

(iv) in order of latest allowable start dates, then in order of preceding event numbers, and then in order of succeeding event numbers.

19.3 Submission and approval of the system shall be as follows:

(1) A preliminary network defining the Contractor's planned operations during the first sixty (60) calendar days after notice to proceed will be submitted within ten (10) days. The Contractor's general approach for the balance of the project shall be indicated. Cost of activities expected to be completed or partially completed before submission and approval of the whole schedule should be included.

(2) The complete network analysis consist of the detailed network mathematical analysis (on-site manpower loading schedule, equipment schedule) and network diagrams shall be submitted within forty (40) calendar days after receipt of notice to proceed.

19.4 The Contractor shall participate in a review and evaluation of the proposed network diagrams and analysis by the Contracting Officer. Any revisions necessary as a result of this review shall be resubmitted for approval of the Contracting Officer within ten (10) calendar days after the conference. The approved schedule shall then be the schedule to be used by the Contractor for planning, organizing and directing the work and for reporting progress. If the Contractor thereafter desires to make changes in his method of operating and scheduling he shall notify the Contracting Officer in writing stating the reasons for the change. If the Contracting Officer considers these changes to be of a major nature he may require the Contractor to revise and submit for approval, without additional cost to the Government, all or the affected portion of the detailed diagrams and mathematical analysis and the summary diagram to show the effect on the entire project. A change may be considered of major nature if the time estimated to be required or actually used for an activity or the logic of sequence of activities is varied from the original plan to a degree that there is a reasonable doubt as to the effect on the contract completion date or dates. Changes which affect activities with adequate slack time shall be considered as minor changes, except that an accumulation of minor changes may be considered a major change when their cumulative effect might affect the contract completion date.

19.5 The Contractor shall submit at intervals of fifteen (15) calendar days a report of the actual construction progress by updating the mathematical analyses. Revisions causing changes in the detailed network shall be noted on the summary network, or a revised issue of affected portions of the detailed network furnished. The summary network shall be revised as necessary for the sake of clarity. However, only the initial

submission or complete revisions need be time scaled. Subsequent minor revisions need not be time scaled.

19.6 The report shall show the activities or portions of activities completed during the reporting period and their total value as basis for the Contractor's periodic request for payment. Payment made pursuant to the General Provision entitled "Payments to Contractor" will be based on the total value of such activities completed or partially completed after verification by the Contracting Officer. The report will state the percentage of the work actually completed and scheduled as of the report date and the progress along the critical path in terms of days ahead or behind the allowable dates. If the project is behind schedule, progress along other paths with negative slack shall also be reported. The Contractor shall also submit a narrative report with the updated analysis which shall include but not be limited to a description of the problem areas, current and anticipated, delaying factors and their impact, and an explanation of corrective actions taken or proposed.

19.7 Sheet size of diagrams shall be 30 by 42 inches. Each updated copy shall show a date of the latest revision.

19.8 Initial submittal and complete revisions shall be submitted in six (6) copies.

19.9 Periodic reports shall be submitted in four (4) copies.

15 January 1998

20. WARRANTY OF CONSTRUCTION (MAR 1984) ALTERNATE 1 (APR 1984) FAR 52.246-21I.

#### 20.1 General Requirements.

20.1.1 In addition to any other warranties in this contract, the Contractor warrants, except as provided in paragraph 20.1.10 of this clause, that work performed under this contract conforms to the contract requirements and is free of any defect in equipment, material, or design furnished, or workmanship performed by the Contractor or any subcontractor or supplier at any tier.

20.1.1.1 Warranty Payment: Warranty work is a subsidiary portion of the contract work, and has a value to the Government approximating 1% of the contract award amount. The Contractor will assign a value of that amount in the breakdown for progress payments mentioned in the Contract Clause: Payments Under Fixed-Price Construction Contracts. If the Contractor fails to respond to warranty items as provided in paragraph 20.5, the Government may elect to acquire warranty repairs through other sources and, if so, shall backcharge the Contractor for the cost of such repairs. Such backcharges shall be accomplished under the Changes Clauses of the contract through a credit modification(s).

20.1.2 This warranty shall continue for a period of 1 year from the date of final acceptance of the work. If the Government takes possession of any part of the work before final acceptance, this warranty shall continue for a period of 1 year from the date the Government takes possession.

20.1.3 The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect. In addition, the Contractor shall remedy at the Contractor's expense any damage to Government-owned or controlled real or personal property, when that damage is the result of--

(a) The Contractor's failure to conform to contract requirements; or

(b) Any defect of equipment, material, workmanship, or design furnished.

20.1.4 The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The Contractor's warranty with respect to work repaired or replaced will run for 1 year from the date of repair or replacement.

20.1.5 The Contracting Officer shall notify the Contractor, in writing, (see para. 20.2.3 and 20.5) within a reasonable time after the discovery of any failure, defect, or damage.

20.1.6 If the Contractor fails to remedy any failure, defect, or damage within a reasonable time after receipt of notice, (see para. 20.5) the Government shall have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the Contractor's expense.

20.1.7 With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall--

(a) Obtain all warranties that would be given in normal commercial practice;

(b) Require all warranties to be executed, in writing, for the benefit of the Government, if directed by the Contracting Officer; and

(c) Provide names, addresses, and telephone numbers of all subcontractors, equipment suppliers, or manufacturers with specific designation of their area of responsibilities if they are to be contacted directly on warranty corrections; and

(d) Enforce all warranties for the benefit of the Government, if directed by the Contracting Officer.

20.1.8 In the event the Contractor's warranty under paragraph 20.1.2 of this clause has expired, the Government may bring suit at its expense to enforce a subcontractor's, manufacturer's, or supplier's warranty.

20.1.9 Unless a defect is caused by the negligence of the Contractor or subcontractor or supplier at any tier, the Contractor shall not be liable for the repair of any defects of material or design furnished by the Government nor for the repair of any damage that results from any defect in Government-furnished material or design.

20.1.10 This warranty shall not limit the Government's rights under the Inspection and Acceptance clause of this contract with respect to latent defects, gross mistakes, or fraud.

20.1.11 Defects in design or manufacture of equipment specified by the Government on a "brand name and model" basis, shall not be included in this warranty. In this event, the Contractor shall require any subcontractors, manufacturers, or suppliers thereof to execute their warranties, in writing, directly to the Government.

## 20.2 Performance Bond.

20.2.1 The Contractor's Performance Bond will remain effective throughout the construction warranty period and warranty extensions.

20.2.2 In the event the Contractor or his designated representative(s) fails to commence and diligently pursue any work required under this clause, and in a manner pursuant to the requirements thereof, the Contracting Officer shall have a right to demand that said work be performed under the Performance Bond by making written notice on the

surety. If the surety fails or refuses to perform the obligation it assumed under the Performance Bond, the Contracting Officer shall have the work performed by others, and after completion of the work, may make demand for reimbursement of any or all expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

20.2.3 Following oral or written notification of required warranty repair work, the Contractor will respond as dictated by para. 20.5. Written verification will follow oral instructions. Failure of the Contractor to respond will be cause for the Contracting Officer to proceed against the Contractor as outlined in the paragraph 20.2.2 above.

20.3 Pre-Warranty Conference. Prior to contract completion and at a time designated by the Contracting Officer, the Contractor shall meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this clause. Communication procedures for Contractor notification of warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty shall be established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, the Contractor will furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the warrantied construction, will be continuously available, and will be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of his responsibilities in connection with other portions of this provision.

#### 20.4 Equipment Warranty Identification Tags.

20.4.1 The Contractor shall provide warranty identification tags on all Contractor and Government furnished equipment which he has installed.

(a) The tags shall be similar in format and size to the exhibits provided by this specification, they shall be suitable for interior and exterior locations, resistant to solvents, abrasion, and to fading caused by sunlight, precipitation, etc. These tags shall have a permanent pressure-sensitive adhesive back, and they shall be installed in a position that is easily (or most easily) noticeable. Contractor furnished equipment that has differing warranties on its components will have each component tagged.

(b) Sample tags shall be submitted for Government review and approval. These tags shall be filled out representative of how the Contractor will complete all other tags.

(c) Tags for Warrantied Equipment: The tag for this equipment shall be similar to the following. Exact format and size will be as approved.

---

EQUIPMENT WARRANTY  
CONTRACTOR FURNISHED EQUIPMENT

MFG MODEL NO.

SERIAL NO.

CONTRACT NO.

CONTRACTOR NAME

CONTRACTOR WARRANTY EXPIRES

MFG WARRANTY(IES) EXPIRE

---

---

EQUIPMENT WARRANTY  
GOVERNMENT FURNISHED EQUIPMENT

MFG MODEL NO.

SERIAL NO.

CONTRACT NO.

DATE EQUIP PLACED IN SERVICE

MFG WARRANTY(IES) EXPIRE

---

(d) If the manufacturer's name (MFG), model number and serial number are on the manufacturer's equipment data plate and this data plate is easily found and fully legible, this information need not be duplicated on the equipment warranty tag. The Contractor warranty expires (warranty expiration date) and the final manufacturer's warranty expiration date will be determined as specified by para. 20.1.

20.4.2 Execution. The Contractor will complete the required information on each tag and install these tags on the equipment by the time of and as a condition of final acceptance of the equipment.

20.4.3 Payment. The work outlined above is a subsidiary portion of the contract work, and has a value to the Government approximating 5% of the value of the Contractor furnished equipment. The Contractor will assign a value of that amount in the breakdown for progress payments mentioned in the Contract Clause: PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS.

20.4.4 Equipment Warranty Tag Replacement. As stated in para. 20.1.4, the Contractor's warranty with respect to work repaired or replaced shall run for one year from the date of repair or replacement. Such activity shall include an updated warranty identification tag on the repaired or replaced equipment. The tag shall be furnished and installed by the Contractor, and shall be identical to the original tag, except that the Contractor's warranty expiration date will be one year from the date of acceptance of the repair or replacement.

20.5 Contractor's Response to Warranty Service Requirements.

20.5.1 Following oral or written notification by the Contracting Officer or an authorized representative of the installation designated in writing by the Contracting Officer, the Contractor shall respond to warranty service requirements in accordance with the "Warranty Service Priority List" and the three categories of priorities listed below.

First Priority Code 1 Perform on site inspection to evaluate situation, determine course of action, initiate work within 24 hours and work continuously to completion or relief.

Second Priority Code 2 Perform on site inspection to evaluate situation, determine course of action, initiate work within 48 hours and work continuously to completion or relief.

Third Priority Code 3 All other work to be initiated within 5 work days and work continuously to completion or relief.

The "Warranty Service Priority List" is as follows:

- Code 2     Air Conditioning Systems
  - a. Recreational support.
  - b. Air conditioning leak in part of building, if causing damage.
  - c. Admin buildings with ADP equipment not on priority list.
- Code 1     Doors
  - a. Overhead doors not operational.
- Code 1     Electrical
  - a. Power failure (entire area or any building operational after 1600 hours).
  - b. Traffic control devices.
  - c. Security lights.
- Code 2     Electrical
  - a. Power failure (no power to a room or part of building).
  - b. Receptacle and lights.
  - c. Fire alarm systems.
- Code 1     Gas
  - a. Leaks and breaks.
  - b. No gas to family housing unit or cantonment area.
- Code 2     Heat
  - a. Medical storage.
  - b. Barracks.
- Code 2     Plumbing
  - a. Flush valves.
  - b. Fixture drain, supply line commode, or water pipe leaking.
  - c. Commode leaking at base.
- Code 1     Roof Leaks
  - Temporary repairs will be made where major damage to property is occurring.
- Code 2     Roof Leaks
  - Where major damage to property is not occurring, check for location of leak during rain and complete repairs on a Code 2 basis.
- Code 1     Water (Exterior)
  - Normal operation of water pump station.
- Code 2     Water (Exterior)
  - No water to facility.
- Code 1     Sprinkler System
  - All sprinkler systems, valves, manholes, deluge systems, and air systems to sprinklers.

20.5.2 Should parts be required to complete the work and the parts are not immediately available the Contractor shall have a maximum of 12 hours after arrival at the job site to provide the Contracting Officer or an authorized representative of the installation designated in writing by the Contracting Officer, with firm written proposals for emergency alternatives and temporary repairs for Government participation with the Contractor to provide emergency relief until the required parts are available on site for the Contractor to perform permanent warranty repair. The Contractors proposals shall include a firm date and time that the

required parts shall be available on site to complete the permanent warranty repair. The Contracting Officer or an authorized representative of the installation designated in writing by the Contracting Officer, will evaluate the proposed alternatives and negotiate the alternative considered to be in the best interest of the Government to reduce the impact of the emergency condition. Alternatives considered by the Contracting Officer or an authorized representative of the installation designated in writing by the Contracting Officer will include the alternative for the Contractor to "Do Nothing" while waiting until the required parts are available to perform permanent warranty repair. Negotiating a proposal which will require Government participation and the expenditure of Government funds shall constitute a separate procurement action by the using service.

21. thru 27. NOT USED.

2 January 1991

28. IDENTIFICATION OF GOVERNMENT-FURNISHED PROPERTY (APR 1984) FAR 52.245-3.

28.1 The Government will furnish to the Contractor the property identified in the Schedule to be incorporated or installed into the work or used in performing the contract. The listed property will be furnished at the place specified below. When the property is delivered, the Contractor shall verify its quantity and condition and acknowledge receipt in writing to the Contracting Officer. The Contractor shall also report in writing to the Contracting Officer within 24 hours of delivery any damage to or shortage of the property as received. All such property shall be installed or incorporated into the work at the expense of the Contractor, unless otherwise indicated in this contract.

28.2 The Contractor is required to accept delivery, pay any demurrage or detention charges, and unload and transport the property to the jobsite at its own expense.

28.3 Each item of property to be furnished under this clause shall be identified in the Schedule by quantity, item, and description.

Quantity	Item	Description
3	IRAT	Fire Alarm Transmitter Panel & Antenna

15 June 1990

29. AGGREGATE SOURCES.

29.1 General. The aggregate sources (listed below) for concrete, asphalt, stone-base subbase and DGA have previously met or exceeded the standards specified for the above subject facility, but the material on these ledges must be tested per the technical specifications requirements.

29.2 Coarse aggregate sources that meet or exceed the C-33-90 standards for concrete and KDOH 1998 standards for asphalt, stone-base, subbase and DGA are listed below:

a. Kentucky Stone Company, Canton, Kentucky. Ledges 2 and 3, about 33 feet.

b. Vulcan Materials Company, Gilbertsville, Kentucky. Ledges 4 and 26, about 393 feet.

c. Martin-Marietta Aggregates, Smithland, Kentucky. Ledges 16 to 19, about 51 feet.



d. Hopkinsville Stone Company, Hopkinsville, Kentucky. Ledges 1B, 2A, 2B, 3A, 3B, 3C, 3D, 5,6,7,8, and 10, 11, 12, 13, and 14, about 115 feet.

29.3 Natural fine aggregate sources for asphalt, stone-base, subbase and DGA are listed below:

- a. Delta Materials, Henderson, Kentucky.
- b. Ingram Materials, Paducah, Kentucky.
- c. Mayfield Aggregates, Mayfield, Kentucky.
- d. Delta Materials, Cairo, Illinois.

29.4 Manufactured fine aggregates for concrete, Hopkinsville Stone Company, Hopkinsville, Kentucky.

29.5 Aggregates may be furnished from any of the above listed sources or at the option of the Contractor may be furnished from any other source designated by the Contractor and approved by the Contracting Officer, subject to the conditions hereinafter stated.

29.6 Source. After the award of the contract, the Contractor shall designate in writing only one source or one combination of sources from which he proposes to furnish aggregates. If the Contractor proposes to furnish aggregates from a source or from sources not listed above, he may designate only a single source or single combination of sources for aggregates. Samples for acceptance testing shall be provided as required by the technical portions of these specifications. If a source for coarse or fine aggregate so designated by the Contractor is not approved for use by the Contracting Officer, the Contractor may not submit for approval other sources, but shall furnish the coarse or fine aggregate, as the case may be, from a source listed above at no additional cost to the Government.

29.7 Listing of a concrete aggregate source is not to be construed as approval of all material from that source. The right is reserved to reject materials from certain localized areas, zones, strata, or channels, when such materials are unsuitable for concrete aggregate as determined by the Contracting Officer. Materials produced from an approved source shall meet all requirements of the technical portions of these specifications.

24 February 1992

30. NOT USED.

1 February 1995

(2) 31. PROJECT SIGN.

31.1 General. The Contractor shall furnish and erect at the location directed one project sign.

Exact placement location will be designated by the Contracting Officer. The panel sizes and graphic formats have been standardized for visual consistency throughout all Corps operations.

Panels are fabricated using HDO plywood with dimensional lumber uprights and bracing.

All legends are to be painted in the sizes and styles as specified by the graphic formats shown at the end of this section. The signs (including back and edges), posts and braces shall be given two coats of Benjamin Moore No. 120-60 poly-silicone enamel or approved equal before lettering. The 4' x 4' right section of the project sign shall be white with black lettering. The 2' x 4' left section shall be Communication Red (CR) with white lettering. Paint colors shall be as follow:

Black - Federal Standard 595a Color Number 27038  
White - Federal Standard 595a Color Number 27875  
Red - PANTONE 032

An example of the sign including mounting and fabrication details are also provided at the end of this section.

Name of the project shall be as follows:

XX

Vehicle Maintenance Shops Phase 2

626<sup>th</sup> FSB and 86<sup>th</sup> CSH, PN18636, FY 97

Fort Campbell, Kentucky XX

XX

Name of the designer shall be as follows:

XX

Clark Dietz, Inc./Mills-Wallace & Associates, Inc.

Champaign, Illinois XX

XX

31.2 Erection and Maintenance. The signs shall be erected at the designated location(s). Signs shall be plumb and backfill of post holes shall be well tamped to properly support the signs in position throughout the life of the contract. The signs shall be maintained in good condition until completion of the contract, shall remain the property of the Contractor, and shall be removed from the site upon completion of work under the contract.

31.3 The Corps of Engineers logo will be provided by the Contracting Officer.

31.4 Payment. No separate payment will be made for furnishing and erecting the project signs as specified and costs thereof shall be considered a subsidiary obligation of the Contractor.

32. NOT USED.

1 February 1995

33. WAGE RATES. The decision of the Secretary of Labor, covering rates of wages, including fringe benefits to be paid laborers and mechanics performing work under this contract, is attached hereto. The payment for all classes of laborers and mechanics actually employed to perform work under the contract will be specified in the following contract clauses: DAVIS-BACON ACT, CONTRACT WORK HOURS AND SAFETY STANDARDS ACT, and THE COPELAND ACT.

Wage decisions included are:

TN980059

TN980035

The building decision TN980035 applies to construction of buildings (to the five-foot line) in the State of Tennessee. The Heavy decision TN980059 applies to all other work in Tennessee performed outside the 5 foot building line.

15 June 1990

34. PURCHASE ORDERS. Five copies of all purchase orders, for items requiring shop inspection, showing firm names and addresses, shall be submitted to the Contracting Officer when orders for materials are placed. Orders shall be so worded or marked that each item, piece or member can be definitely identified on the drawings. Purchase prices are not necessary and may be obliterated from the copies of the purchase orders furnished.

15 June 1990

35. INTERFERENCE WITH TRAFFIC AND PUBLIC AND PRIVATE PROPERTY.

35.1 The Contractor at all times shall dispose his plant and conduct the work in such manner as to cause as little interference as possible with private and public travel. Damage (other than that resulting from normal wear and tear) to roads, shall be repaired to as good a condition as they were prior to the beginning of work and to the satisfaction of the Contracting Officer.

35.2 Not Used.

15 September 1995

36. SEQUENCE OF WORK.

36.1 The Contractor at all times shall dispose his plant and conduct the work in such manner as to cause as little interference as possible with private and public travel. Damage (other than that resulting from normal wear and tear) to roads, shall be repaired to as good a condition as they were prior to the beginning of work and to the satisfaction of the Contracting Officer.

37. NOT USED.

1 August 1996

38. COMPLIANCE WITH POST/BASE REGULATIONS. The site of the work is on a military reservation and all rules and regulations issued by the Commanding Officer covering general safety, security, sanitary requirements, pollution control and traffic regulations, shall be observed by the Contractor. Information regarding these requirements may be obtained by contacting the Contracting Officer, who will provide such information or assist in obtaining same from appropriate authorities.

38.1 Contractor personnel shall park only in areas authorized by the Contracting Officer.

20 March 1997

39. EQUIPMENT AND OWNERSHIP AND OPERATING EXPENSE SCHEDULE (MAR 1995) EFAR 52.231-5000.

39.1 This does not apply to terminations. See 52.249,5000, Basis for Settlement of Proposals and FAR Part 49.

39.2 Allowable cost for construction and marine plant and equipment in sound workable condition owned or controlled and furnished by a contractor or subcontractor at any tier shall be based on actual cost data for each piece of equipment or groups of similar serial and series for which the Government can determine both ownership and operating costs from the contractor's accounting records. When both ownership and operating costs cannot be determined for any piece of equipment or groups of similar serial or series equipment from the contractor's accounting records, costs for that equipment shall be based upon the applicable provisions of EP 1110-1-8, Construction Equipment Ownership and Operating Expense Schedule, Region II. Working conditions shall be considered to be average for determining equipment rates using the schedule unless specified otherwise by the Contracting Officer. For equipment not included in the schedule, rates for comparable pieces of equipment may be used or a rate may be developed using the formula provided in the schedule. For forward pricing, the schedule in effect at the time of negotiations shall apply. For retroactive pricing, the schedule in effect at the time of negotiations shall apply.

39.3 Equipment rental costs are allowable, subject to the provisions of FAR 31.105(d)(ii) and FAR 31.205-36. Rates for equipment rented from an organization under common control, lease-purchase arrangements, and sale-leaseback arrangements, will be determined using the schedule, except that actual rates will be used for equipment leased from an organization

under common control that has an established practice of leasing the same or similar equipment to unaffiliated lessees.

39.4 When actual equipment costs are proposed and the total amount of the pricing action exceeds the small purchase threshold, the Contracting Officer shall request the Contractor to submit either certified cost or pricing data, or partial/limited data, as appropriate. The data shall be submitted on Standard Form 1411, Contract Pricing Cover Sheet.

39.5 Whenever a modification or equitable adjustment of contract price is required, the contractor's cost proposals for equipment ownership and operating expenses shall be determined in accordance with the requirements of SPECIAL CONTRACT REQUIREMENT: EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE. A copy of EP 1110-1-8, "Construction Equipment Ownership and Operating Expense Schedule" is available for review at the office of the District Engineer, Room 821, 600 Dr. Martin Luther King, Jr. Place, Louisville, Kentucky, or a copy may be ordered from the Government Printing Office at a cost of \$11.00 by calling telephone no. (301) 953-7974.

Address to Order: U.S. Government Printing Office  
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8160 Cherry Lane  
Laurel, MD 20707

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8	008-022-00261-8
9	008-022-00262-6
10	008-022-00263-4
11	008-022-00264-2
12	008-022-00265-1

15 June 1990

#### 40. LABOR, EQUIPMENT, AND MATERIAL REPORTS.

40.1 Daily Equipment Report. The Contractor shall submit a daily report of all Contractor-owned or rented equipment at the jobsite. A similar report is required for all subcontractor equipment. The subcontractor's report may be separate or included with the Contractor's report provided the equipment is adequately identified as to ownership. The required equipment report shall include each item of equipment (hand-operated small tools or equipment excluded) on the job and shall specifically identify each item as to whether it is Contractor-owned or rented, shifts, hours of usage, downtime for repairs, and standby time. Identification of the equipment shall include make, model and plant number of all items. Separate identification by a key sheet providing these data may be utilized with the daily report indicating the type of equipment and the equipment plant numbers. The format of the Daily Equipment Report will be as approved by the Government in the field.

40.2 Labor, Equipment & Material Reports for Extra Work/Cost. A Report shall also be submitted by the Contractor listing any labor, equipment and materials expended on and/or impacted by any change order directed by the Government and for which total price/time agreement has not been reached. These requirements also apply to subcontractors at any tier. The same Report is required at any time the Contractor claims or intends to claim for extra costs whether or not there is Government recognition

(constructive changes). This requirement is in addition to any Contractor "Notice" or "Reservation of Rights". Submittal of such a report will not be construed as satisfying the "Notice" required under the "Changes" clause or any other clause. But, absence of such Reports submitted to the Government contemporaneously with the alleged extra work/cost will be considered as evidence that no such extra work/cost occurred that are chargeable to the Government.

40.2.1 The Report shall be detailed to the degree required by the Government in the field and shall contain the following as a minimum:

- a. The cause of the extra labor, equipment or materials costs.
- b. For extra labor - Indicate crew, craft, hours, location and cost. Describe nature or type of extra costs, i.e, extra work, overtime, acceleration, interference, reassignment, mobilizations and demobilizations, supervision, overhead, type of inefficiency, etc.
- c. For extra equipment - Indicate type and description, hours, location, cost; whether working, idle, standby, under repair, extra work involved, etc.
- d. For extra materials - Indicate type and description, where used, whether consumed, installed or multi-use, quantity, cost, extra work involved, etc.
- e. Affected activities - Relate to Contract Schedule (Network Analysis); demonstrate whether delay or suspension is involved.
- f. Segregate all entries by prime and each subcontractor.
- g. Summarize costs daily and by cumulative subtotal or with frequency required by the Government.

40.3 This Report will not be considered as evidence that any of the alleged extra costs actually occurred. The Report will be used to check against over obligation of funds for change orders directed prior to price/time agreement and to track alleged extra costs the Contractor considers otherwise chargeable against the Government. The Government may respond at any interval to either challenge, amend or confirm the Report. Absence of a Government response is not to be considered acquiescence or denial. The Government may order work stoppage if deemed necessary to avoid overobligation of funds. The frequency of the report shall be daily or as otherwise approved by the Government representative in writing.

41. NOT USED.

24 January 1994

(3) 42. PROGRESS PHOTOGRAPHS. The Contractor shall, during the progress of the work, furnish the Contracting Officer photographs, slides and negatives to depict progress of construction. The photographic work shall be commercial quality as determined by the Contracting Officer. The photography shall be performed between the first and fifth of each month and the photographs, slides and negatives delivered to the Contracting Officer not later than the 15th of each month taken. A maximum of six views from different positions shall be taken as directed to show, inasmuch as possible, work accomplished during the previous month. At least, one set of photographs, slides and negatives shall be made at completion of the contract after the final inspection by the Contracting Officer. The photographs shall be 8"x10" color prints and the slides 35 mm color. Each photograph and slide shall be identified on the face of the picture or the border of the slide giving the date made, contract title and number, location of work, as well as a brief description of work depicted. Each negative will be identified with the same information on a sheet of paper

by cross-referencing to the number on the negative. Two copies of photographs and slides, along with the original negatives of each view taken, shall be furnished to the Contracting Officer by the time stipulated above. No separate payment will be made for these services and all costs in connection thereto shall be considered a subsidiary obligation of the Contractor.

20 March 1997

43. PAYMENT FOR MATERIALS DELIVERED OFFSITE. (MAR 1995) EFARS 52.232-5000.

43.1 Pursuant to CONTRACT CLAUSE: PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS, materials delivered to the Contractor at locations other than the site of the work may be taken into consideration in making payments if included in payment estimates and if all the conditions of the CONTRACT CLAUSES are fulfilled. Payment for items delivered to locations other than the worksite will be limited to:

(1) Materials required by the technical provisions,

(2) Materials that have been fabricated to the point where they are identifiable to an item of work required under this contract.

43.2 Such payment will be made only after receipt of paid or receipted invoices or invoices with canceled check showing title to the items in the prime contract and including the value of material and labor incorporated into the item.

44. NOT USED.

17 July 1992

45. INSURANCE--WORK ON A GOVERNMENT INSTALLATION (SEP 1989) FAR 52.228-5.

45.1 The Contractor shall, at its own expense, provide and maintain during the entire performance of this contract at least the kinds and minimum amounts of insurance required in the Schedule or elsewhere in the contract.

(1) Coverage complying with State laws governing insurance requirements, such as those requirements pertaining to Workman's Compensation and Occupational Disease Insurance. Employer's Liability Insurance shall be furnished in limits of not less than \$100,000.00 except in states with exclusive or monopolistic funds.

(2) Comprehensive General Liability Insurance for bodily injury coverage shall be furnished in limits of not less than \$500,000 per occurrence.

(3) Comprehensive Automobile Liability Insurance for both bodily injury and property damage, shall be furnished in limits of not less than \$200,000.00 per person, \$500,000.00 per accident for bodily injury, and \$20,000.00 per accident for property damage. When the Financial Responsibility or Compulsory Insurance Law of the State, requires higher limits, the policy shall provide for coverage of at least those higher limits.

45.2 Before commencing work under this contract, the Contractor shall certify to the Contracting Officer in writing that the required insurance has been obtained. The policies evidencing required insurance shall contain an endorsement to the effect that any cancellation or any material change adversely affecting the Government's interest shall not be effective (1) for such period as the laws of the State in which this contract is to be performed prescribe, or (2) until 30 days after the insurer or the

Contractor gives written notice to the Contracting Officer, whichever period is longer.

45.3 The Contractor shall insert the substance of this clause, including this paragraph (45.3), in subcontracts under this contract that require work on a Government installation and shall require subcontractors to provide and maintain the insurance required in the Schedule or elsewhere in the contract. The Contractor shall maintain a copy of all subcontractors' proofs of required insurance, and shall make copies available to the Contracting Officer upon request.

1 August 1996

46. IMPLEMENTATION OF GOVERNMENT RESIDENT MANAGEMENT SYSTEM

46.1 The Contractor shall utilize a Government furnished software program titled, "RMS" (Resident Management System) to maintain critical information needed to manage the project. RMS produces up-to-date management and analysis reports as well as a majority of the forms required in this contract for submission to the Government. Some of these forms are shown as samples at the end of this section. They include ENG 4288 (Submittal Register), ENG 4025 (Transmittal form), CQC Daily Report, Transfer Property Information Form, Definable Feature of Work Form, User Schooling Information Form, Quality Control Testing Information, and Installed Property Information Form.

46.2 The following hardware and software are needed by the Contractor to run RMS: a personal computer with 80386 process (or higher) and four megabytes (MB) or more of random access memory (RAM) and a 3 ½ inch high density floppy drive. Also needed is a HP Laser Jet Series II, III, IV or V printer, a color monitor, MS-DOS, version 5.0 or later, Word Perfect, version 5.1 or later, and Computer files = 81.

46.3 Once the Contract is awarded, the Contractor will be given a cop of the RMS program for implementation. A meeting between the Government and the Contractor will be arranged to inform the Contractor on the use of the software package which is similar to the one the Government will use to manage the project. File updates will be transferred to the Government by disk on a weekly basis, unless electronic transfers are agreed on.

47. NOT USED.

15 June 1990

48. DEFINITIONS. The following provision is applicable to the SPECIFICATIONS, of this solicitation: The term GENERAL PROVISIONS shall mean CONTRACT CLAUSES, the terms SPECIAL PROVISIONS and SPECIAL CLAUSES shall mean SPECIAL CONTRACT REQUIREMENTS.

49. NOT USED.

2 January 1991

50. TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER. ER 415-1-15 (31 OCT 89)

50.1 This provision specifies the procedure for the determination of time extensions for unusually severe weather in accordance with the contract clause entitled "Default: Fixed Price Construction)". In order for the Contracting Officer to award a time extension under this clause, the following conditions must be satisfied:

50.1.1 The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.

50.1.2 The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the Contractor.

50.2 The following schedule of monthly anticipated adverse weather delays is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations. The Contractor's progress schedule must reflect these anticipated adverse weather delays in all weather dependent activities.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY  
WORK DAYS BASED ON (5) DAY WORK WEEK

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
(09)	(06)	(06)	(06)	(05)	(04)	(05)	(04)	(04)	(04)	(04)	(06)

50.3 Upon acknowledgment of the Notice to Proceed (NTP) and continuing throughout the contract, the Contractor will record on the daily CQC report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delay days must prevent work on critical activities for 50 percent or more of the Contractor's scheduled work day. The number of actual adverse weather delay days shall include days impacted by actual adverse weather (even if adverse weather occurred in previous month), be calculated chronologically from the first to the last day of each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in paragraph 50.2, above, the Contracting Officer will convert any qualifying delays to calendar days, giving full consideration for equivalent fair weather work days, and issue a modification in accordance with the contract clause entitled "Default (Fixed Price Construction)".

1 August 1996

51. NOT USED.

4 June 1993

52. USE OF INCLINOMETER FOR LONG BED DUMP TRUCKS (DACF BULLETIN 25 MARCH 1993) The recommendation of EM 385-1-1, Section 16.B.15, is mandatory for this project.

20 March 1997

53. AVAILABILITY OF SAFETY AND HEALTH REQUIREMENTS MANUAL (EM 385-1-1).

As covered by CONTRACT CLAUSE "ACCIDENT PREVENTION", compliance with EM 385-1-1 is a requirement for this contract. Copies may be purchased for \$31.00 each at the following address:

United States Government Bookstore  
Room 118, Federal Building  
1000 Liberty Avenue  
Pittsburgh, PA 15222  
Telephone: (412) 644-2721  
FAX: (412) 644-4547

15 April 1991

54. FIRE PROTECTION DURING CONSTRUCTION (MIL-HDBK-1008b Para. 2.9.2) The Contractor is alerted to the requirements of Contract Clause "CLEANING UP" and more specifically to the requirements for fire protection during construction spelled out in EM 385-1-1 and NFPA No. 241 Building Construction and Demolition Operations. This item must be covered in the submittal required under Contract Clause "ACCIDENT PREVENTION".

55. thru 57. NOT USED.



1 November 1991

58. CONSTRUCTION HAZARD COMMUNICATION. The Contractor is required to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1926.59). This standard is designed to inform workers of safe and appropriate methods of working with hazardous substances in the workplace. The standard has five requirements, and every hazardous or potentially hazardous substance used or stored in the work area is subject to all five. They are:

(1) Hazard Evaluation. Any company which produces or imports a chemical or compound must conduct a hazard evaluation of the substance to determine its potential health or physical hazard. The hazard evaluation consists of an investigation of all the available scientific evidence about the substance. The Contractor is required to assure that all producers (manufacturer/distributors) have performed these evaluations and transmit the required information with any hazardous materials being used or stored on the project site. From the hazard evaluation, a substance may be classified as a health hazard, or a physical hazard. These classifications are then further broken down according to type:

Health Hazards	Physical Hazards
Carcinogens	Combustible liquids
Irritants	Compressed gases
Sensitizers	Explosives
Corrosives	Flammables
Toxic substances	Organic peroxides
Highly toxic substances	Unstable substances
Substances harmful to specific organs or parts of the body	Water-reactive substances

(2) Warning Labels. If a chemical is hazardous or potentially hazardous, the producer or importer must affix a warning label to every container of that chemical before it leaves his facility. The Contractor must assure these labels are attached and legible. The label must identify the chemical, state the hazard, and give the name and address of the producer or importer. If the hazardous substance is transferred to another container, that container must then be labeled, tagged, or marked with the name of the chemical and the appropriate hazard warning. Warning labels should be replaced immediately if they are defaced or removed.

(3) Material Safety Data Sheets. The producer or importer must also supply a material safety data sheet (MSDS). The Contractor must keep these available in the work area where the substance is used, so that the people using the substance can easily review important safety and health information, such as:

The hazard possible from misuse of the substance  
Precautions necessary for use, handling, and storage  
Emergency procedures for leaks, spills, fire and first aid  
Useful facts about the substance's physical or chemical properties

(4) Work Area Specific Training. Because of hazardous substance may react differently depending on how it is used or the environment of the work area, the Contractor must conduct work area specific training; special training which takes the Contractor's operations, environment, and work policies into consideration. Work area training presents:

The hazardous substances which are present in the work place and the hazards they pose

Ways to protect against those hazards, such as protective equipment, emergency procedures, and safe handling

Where the MSDS's are kept, and an explanation of the labeling system  
Where the Contractor's written Hazard Communication Program is located

(5) The Written Hazard Communication Program. In accordance with OSHA requirements, the Contractor must prepare a written Hazard Communication Program. This document will be included in the Contractor's Accident Prevention Plan. This document states how the Contractor plans to ensure that hazardous materials are appropriately labeled, how and where MSDS's will be maintained, and how employees will be provided with specific information and training.

15 June 1990

59. CORPS OF ENGINEERS PLAQUE. At the location directed by the Contracting Officer, the Contractor shall mount a Government furnished plaque. Mounting shall be with expansion bolts and rosettes. A photostatic copy of this plaque is bound at the end of these SPECIAL CONTRACT REQUIREMENTS.

24 FEBRUARY 1992

61. MECHANICAL ROOM LAYOUT (ORL). Detailed mechanical room layout drawings shall be submitted for approval in accordance with SD-04 Section 01330. Layout drawings shall show location and maintenance clearances for all mechanical room equipment, and all utility runs/chases for mechanical, electrical, telephone and other similar systems. Drawings shall be submitted at the same time as the submittals for the equipment to be located within the mechanical room.

62. thru 68. NOT USED.

2 January 1996

69. BASIS FOR SETTLEMENT OF PROPOSALS. EFARS 52.249-5000. Actual costs will be used to determine equipment costs for a settlement proposal submitted on the total cost basis under FAR 49.206-2(b). In evaluating a terminations settlement proposal using the total cost basis, the following principles will be applied to determine allowable equipment costs:

(1) Actual costs for each piece of equipment, or groups of similar serial or series equipment, need not be available in the contractor's accounting records to determine total actual equipment costs.

(2) If equipment costs have been allocated to a contract using predetermined rates, those charges will be adjusted to actual costs.

(3) Recorded job costs adjusted for allowable expenses will be used to determine equipment operating expenses.

(4) Ownership costs (depreciation) will be determined using the contractor's depreciation schedule (subject to the provisions of FAR 31.205-11).

(5) License, taxes, storage and insurance costs are normally recovered as an indirect expense and unless the contractor charges these costs directly to contracts, they will be recovered through the indirect expense rate.

70. NOT USED.

8 October 1996

71. PARTNERING. In order to most effectively and efficiently accomplish the work provided for in this contract, the Government is encouraging the formation of a cohesive, mutually beneficial partnership with the Contractor and its subcontractors. This partnership would strive to draw on the strengths, skills, and knowledge of each organization in an

effort to achieve a quality project, done right the first time, within budget, safely, and on schedule. Partnering still requires full compliance with the contract, but the focus of partnering is to build cooperative relationships, avoid or minimize disputes and actively pursue the attainment of common goals by the contracting parties. Success will be dependent upon teamwork characterized by open and effective communication while always adhering to the highest of professional standards. The partnership would be bilateral in makeup and participation will be totally voluntary. Any cost associated with effectuating this partnership will be agreed to by both parties and will be shared equally with no change in contract price.

72. thru 81. NOT USED.

20 March 1997

82. APPROVAL OF CONTRACT (DEC 1989) FAR 52.204-1

This contract is subject to the written approval of the Colonel, Corps of Engineers Commander and District Engineer, Louisville District, and shall not be binding until so approved.

22 June 1998

83. YEAR 2000 COMPLIANCE

a. In accordance with FAR 39.106, the Contractor shall ensure that with respect to any design, construction, goods, or services under this contract as well as any subsequent task/delivery orders issued under this contract (if applicable), all information technology contained therein shall be Year 2000 compliant. Specifically:

b. The Contractor shall:

(1) Perform, maintain, and provide an inventory of all major components to include structures, equipment, items, parts, and furnishings under this contract and each task/delivery order which may be affected by the Y2K compliance requirements.

(2) Indicate whether each component is currently Year 2000 compliant or requires an upgrade for compliance prior to government acceptance.

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GENERAL DECISION TN980035 02/13/98 TN35  
General Decision Number TN980035

Superseded General Decision No. TN970035

State: Tennessee

Construction Type:  
BUILDING

County(ies):  
MONTGOMERY

BUILDING CONSTRUCTION PROJECTS (does not include residential construction consisting of single family homes and apartments up to and including 4 stories)

Modification Number	Publication Date
0	02/13/1998

COUNTY(ies):  
MONTGOMERY

SUTN1008A 07/01/1989	Rates	Fringes
BRICKLAYERS	\$9.07	
CARPENTERS (Including drywall hangers)	9.64	
ELECTRICIAN (Including fire alarms and intercoms)	9.80	
IRONWORKERS	9.00	
LABORERS (Including brick tenders, exterminating and landscaping)	6.11	
PAINTERS (Excluding drywall finishing)	8.71	.25
PLUMBERS (Including HVAC work)	11.44	.35
POWER EQUIPMENT OPERATORS: ROLLER	7.31	
ROOFERS	7.23	

-----  
WELDER -- Receive rate prescribed for craft performing operation to which welding is incidental.  
-----

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after

award only as provided in the labor standards contract clauses (29 CFR 5.5(a)(1)(v)).

---

In the listing above, the "SU" designation means that rates listed under that identifier do not reflect collectively bargained wage and fringe benefit rates. Other designations indicate unions whose rates have been determined to be prevailing.

#### WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- \* an existing published wage determination
- \* a survey underlying a wage determination
- \* a Wage and Hour Division letter setting forth a position on a wage determination matter
- \* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations  
Wage and Hour Division  
U. S. Department of Labor  
200 Constitution Avenue, N. W.  
Washington, D. C. 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator  
U.S. Department of Labor  
200 Constitution Avenue, N. W.  
Washington, D. C. 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review

Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board  
U. S. Department of Labor  
200 Constitution Avenue, N. W.  
Washington, D. C. 20210

4.) All decisions by the Administrative Review Board are final.  
END OF GENERAL DECISION



GENERAL DECISION TN980059 02/13/98 TN59  
General Decision Number TN980059

Superseded General Decision No. TN970059

State: Tennessee

Construction Type:  
HEAVY

County(ies):

BLOUNT	MADISON	SEVIER
GRAINGER	MARION	UNION
JEFFERSON	MONTGOMERY	
KNOX	SEQUATCHIE	

HEAVY CONSTRUCTION PROJECTS

Modification Number	Publication Date
0	02/13/1998

COUNTY(ies):

BLOUNT	MADISON	SEVIER
GRAINGER	MARION	UNION
JEFFERSON	MONTGOMERY	
KNOX	SEQUATCHIE	

SUTN2001A 09/25/1991

	Rates	Fringes
BRICKLAYER	8.84	
CARPENTER	8.58	
CONCRETE FINISHER	8.34	
DRILL OPERATOR (Caisson)	13.98	
ELECTRICIANS	11.89	
IRONWORKERS:		
Reinforcing	8.41	
Structural	10.00	
LABORERS:		
GROUP 1	5.93	
GROUP 2	7.54	

#### LABORER CLASSIFICATIONS

GROUP 1:

Unskilled Laborers; Flaggers

GROUP 2:

Skilled Laborers: Air Tool Operator; Asphalt Raker; Chain Saw Operator; Concrete Mixer Operator (Less than 1 yard); Concrete Rubber/Edger; Fence Erector; Form Setter (Steel Road); Guard Rail Erector; Mechanic's Tender (Tire Changer or Oiler);

Mortar Mixer; Nozzelman or Gun Operator (Gunitite); Pipelayer;  
Sign Erector.

MECHANIC:

Heavy Duty	9.00
Light Duty	8.91

PAINTER & SANDBLASTER	9.52
-----------------------	------

POWDER PERSON (Blaster)	8.03
-------------------------	------

POWER EQUIPMENT OPERATORS:

GROUP 1	9.17
GROUP 2	8.50
GROUP 3	8.31
GROUP 4	7.79

GROUP 5	10.18
GROUP 6	6.56

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1:

Backhoe/Hydraulic Excavator (3/4 Yard & Over), Crane, End Loader (3 Yards & Over), Motor Patrol (Finish), Pile Driver, Dragline.

GROUP 2:

Backhoe/Hydraulic Excavator (Less Than 3/4 Yard), Bull Dozer or Push Dozer, End Loader (Less than 3 yards), Motor Patrol Operator (Rough), Tractor (Crawler/Utility), Scraper, Shovel, Trenching Machine.

Group 3:

Asphalt Paver, Concrete Finishing Machine, Concrete Paver, Scale Spreader (Self-Propelled), Concrete Grinder, Asphalt Milling Machine, Boring Machine Operator (Horizontal)

GROUP 4:

Bobcat, Central Mixing Plant, Concrete Pump, Concrete Saw, Curb Machine (Automatic or Manual), Dozer or Loader Operator (Stockpile), Drill Operator (Piling), Mulcher or Seeder, Rock Drill (Truck Mounted), Roller (Asphalt), Roller (Compaction Self-Propelled), Soil Stabilization Machine, Tractor (Boom & Hoist), Bituminous Distributor Machine, Pump, Track Drill, Striping Machine Operator.

GROUP 5:

Sweeping Machine Operator

GROUP 6:

Farm Tractor Operator

TRUCK DRIVERS:

(2 or 3 Axles)	7.37
(4 or 5 Axles-Heavy Duty)	7.55

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

=====

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200 Constitution Avenue, N. W.  
Washington, D. C. 20210

4.) All decisions by the Administrative Review Board are final.  
END OF GENERAL DECISION

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[illegible]



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# STATEMENT AND ACKNOWLEDGMENT

FORM APPROVED OMB NO  
9000-0014

Public reporting burden for this collection of information is estimated to average .15 hours per response, including the time for reviewing instructions. Searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the suggestions for reducing this burden, to the FAR Secretarial (VRS), Office of Federal Acquisition and Regulatory Policy, GSA Washington, D.C. 20405: and to the Office of Management and Budget, Paperwork Reduction Project (9000-0014), Washington, D.C. 20503

## PART I - STATEMENT OF PRIME CONTRACTOR

1. PRIME CONTRACT NO.	2. DATE SUBCONTRACT AWARDED	3. SUBCONTRACT NUMBER
4. PRIME CONTRACTOR (Name, address and ZIP code)		5. SUBCONTRACTOR (Name, address and ZIP code)
6. The prime contractor states that under the contract shown in item 1, a subcontract was awarded on date shown in item 2 by (Name of Awarding Firm)		

to the subcontractor identified in item 5, for the following work:

7. PROJECT	8. LOCATION	
9. NAME AND TITLE OF PERSON SIGNING	10. BY (Signature)	11. DATE SIGNED

## PART II - ACKNOWLEDGMENT OF SUBCONTRACTOR

12. The subcontractor acknowledges that the following clauses of the contract shown in item 1 are included in this subcontract:

Contract Work Hours and Safety	David-Bacon Act
Standards Act - Overtime	Apprentices and Trainees
Compensation - Construction	Compliance with Copeland Regulations
Payrolls and Basic Records	Subcontracts
Withholding of Funds	Contract Termination-Debarment
Disputes Concerning Labor Standards	Certification of Eligibility

13. NAME(S) OF ANY INTERMEDIATE SUBCONTRACTORS, IF ANY

14. NAME AND TITLE OF PERSON SIGNING	15. BY (Signature)	16. DATE SIGNED
--------------------------------------	--------------------	-----------------

24 October 1988

(Sample of Typical contractor Quality report)

CONTRACTOR'S NAME  
(Address)

DAILY CONSTRUCTION QUALITY CONTROL REPORT

Contract No: \_\_\_\_\_ Date: \_\_\_\_\_ Report No. \_\_\_\_\_  
Project Name \_\_\_\_\_  
Weather: (Clear) (P. Cloudy) (Cloudy); Temperature: \_\_\_\_\_Min. \_\_\_\_\_Max; \_\_\_\_\_Rainfall \_\_\_\_\_in.

<u>Contractor/Subcontractors/Supplier</u>	<u>Area of Responsibility</u>
a. _____	_____
b. _____	_____
c. _____	_____
d. _____	_____
e. _____	_____
f. _____	_____
g. _____	_____

1. Definable Features of Construction in Progress: (Give briefly only definable features of work in progress and location. Refer to work performed by prime and/or subcontractor and/or supplier by letter in table above).

- 
2. Material and/or Equipment Delivered to site: \_\_\_\_\_

- 
3. Results of Surveillance: \_\_\_\_\_

Preparatory Phase (Attach minutes):

Initial Phase (Attach minutes):

Follow-up Phase (Include satisfactory work completed and/or deficiencies with action to be taken):

24 October 1988

4. Tests Required by Plans and/or Specification Performed and results of Test:  
(Attach results of test taken on previous dates).

- 
5. Verbal Instructions Received: (List any instructions given by Government Personnel on construction deficiencies. Retesting required, etc., with action to be taken).

- 
6. Safety Deficiencies Noted. (Describe corrective actions taken).

- 
7. Remarks: (Cover any conflicts in plans, specifications, or instruction).

---

CONTRACTOR'S VERIFICATION: The above report is complete and correct and all material and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications except as noted above.

---

Contractor's Authorized QC Representative

All Construction Project Identification signs and Safety Performance signs are to be fabricated and installed as described below. The signs are to be erected at a location designated by the Contracting Officer and shall conform to the size, format and typographic standards shown.

The sign panels are to be fabricated from .75" High Density Overlay Plywood.

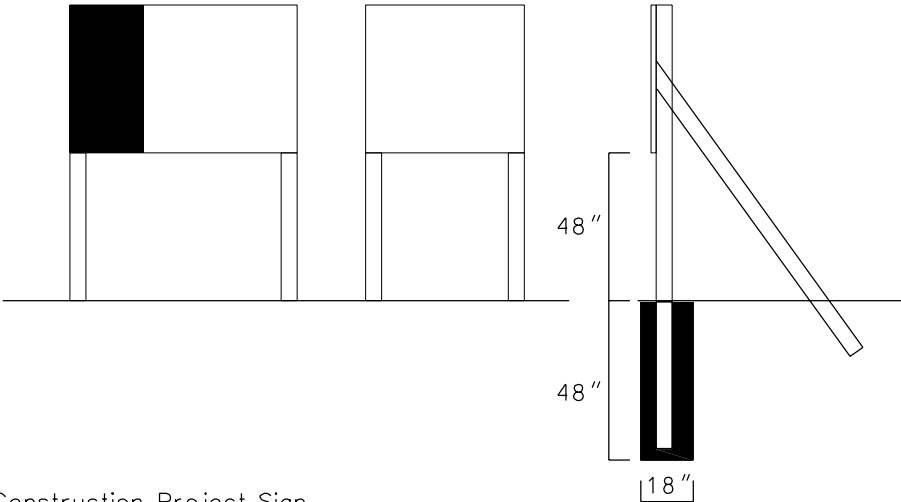
All graphics are to be applied to the background panel following the graphic formats as indicated.

Drill and insert six (6) .375" T-nuts from the front face of the HDO sign panel. Flange or T-nut to be flush with sign face.

Apply lettering and logo to prepared HDO plywood panel.

Sign uprights to be structural grade 4"x4" treated Douglas Fir or Southern Yellow Pine, No.1 or better. Post to be 12' long. Drill six (6) align with T-nuts in sign panel. Counterbore (.5') back of holes to accept socket head cap screw (4"x.375").

Assemble sign panel and uprights. Embed assembled sign panel and uprights in 4' holes. Bolt additional 2"x4" struts on inside face of uprights to reinforce installation as shown



Construction Project Sign  
Legend Group 1: Corps Relationships

1. [ ]
2. [ ]

Legend Group 2: Corps Signature

1. U.S. Army Corps
2. of Engineers

Legend Group 2A: District Name

1. [ ]
2. [ ]

Legend Group 3: Project Title

1. [ ]
2. [ ]

Legend Group 4: Facility Name

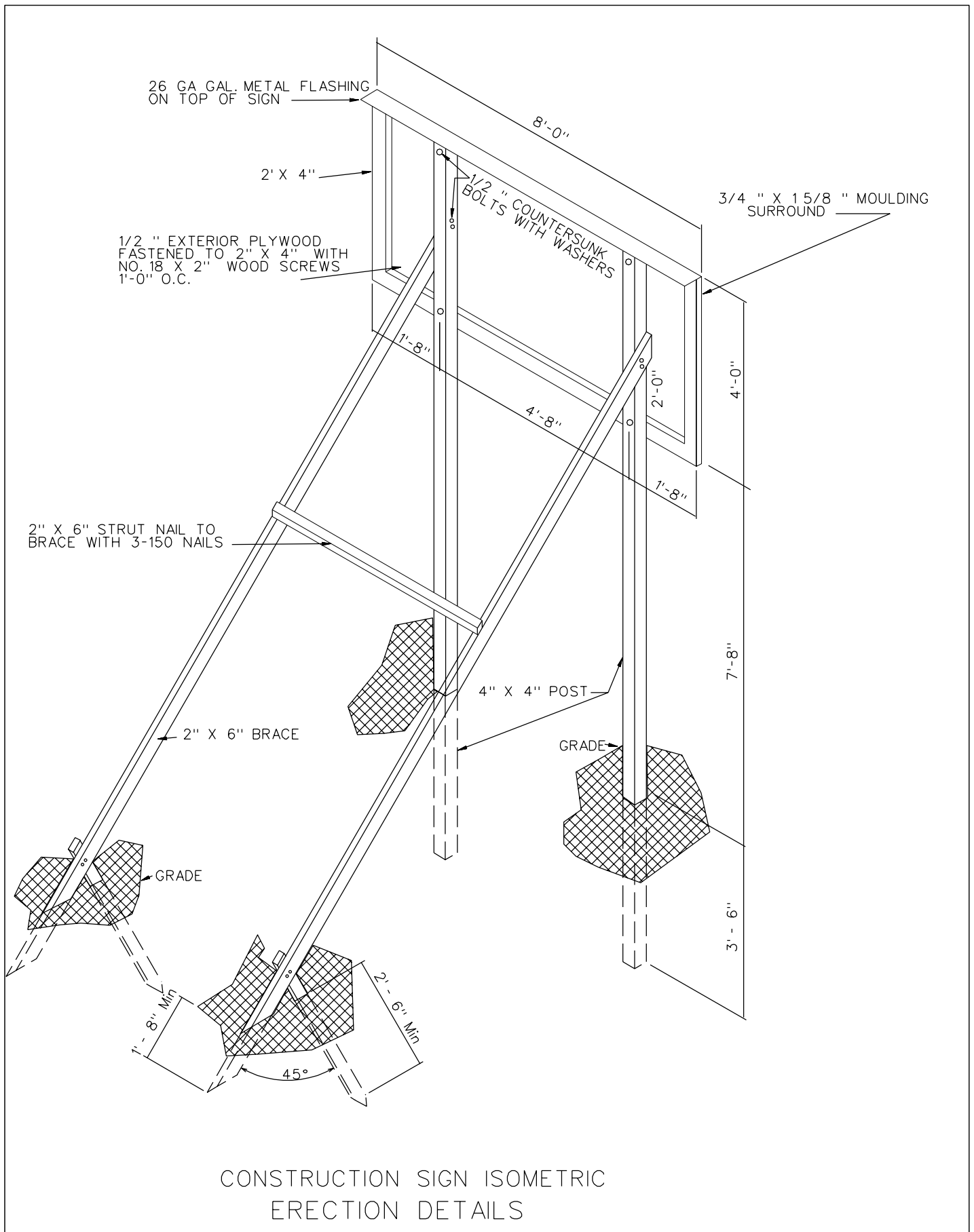
1. [ ]
2. [ ]

Legend Group 5a: Designer

1. [ ]
2. [ ]
3. [ ]
4. [ ]
5. [ ]

Legend Group 5b: Contractor

1. [ ]
2. [ ]
3. [ ]
4. [ ]
5. [ ]



## Introduction: Project Identification Sign

Below are two samples of the construction project identification sign showing how this panel is adaptable for use to identify either civil works projects with a local sponsor (top) or military (bottom). The graphic format for this 4'x6' sign panel follows the legend guidelines and layout as specified

below. The large 4'x4' section of the panel on the right is to be white with black legend. For the top sign, the upper left 2'x2' section of the sign with the full Corps signature is to be painted Communications Red with white lettering. The lower left 2'x2' section of the sign shall match the local sponsor's colors

with white lettering. For the bottom sign, the 2'x4' left section of the sign with full Corps signature is to be painted Communications Red with white lettering. Mounting and fabrication details are provided.

Legend Group 1: One-to Two-line description of Corps relationship to project.

Color: White

Typeface: 1.25" Helvetica Regular Maximum line length: 19"

Legend Group 2: Two-line Corps Signature (US Army Corps of Engineers). Placed below Corps Castle

Color: White

Typeface: Helvetica Bold

Legend Group 2a:

District Name. Placed below

Signature (6: Castle).

Color: White

Typeface: 1.25" Helvetica Regular

Legend Group 3: Words "Local Sponsor"

Color: White

Typeface: 1.2" Helvetica Regular

Maximum length: 19"

Legend Group 4: One-to-three lines for name of local sponsor

Color: White

Typeface: 1.5" Helvetica Regular

Legend Group 5: One-to three-line project title legend describes the work being done under this contract.

Color: Black

Typeface: 3' Helvetica Bold

Maximum line length: 42"

Legend Group 6: One-to two-line identification of project or facility (civil works) or name of sponsoring department (military).

Color: Black

Typeface: 1.5" Helvetica Regular

Maximum line length: 42"

Cross-align the first line of Legend Group 5 with the first line of the /Corps Signature (US Army Corps) as shown.

Legend Groups 7a-b: One-to five-line identification of prime contractors including: type

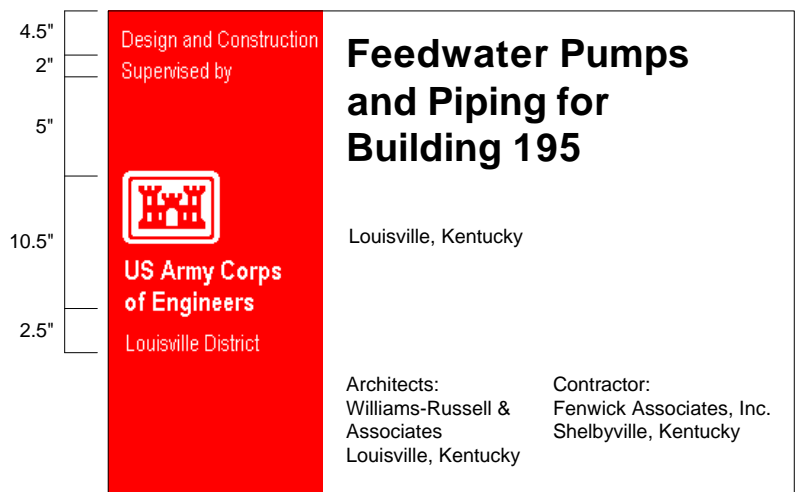
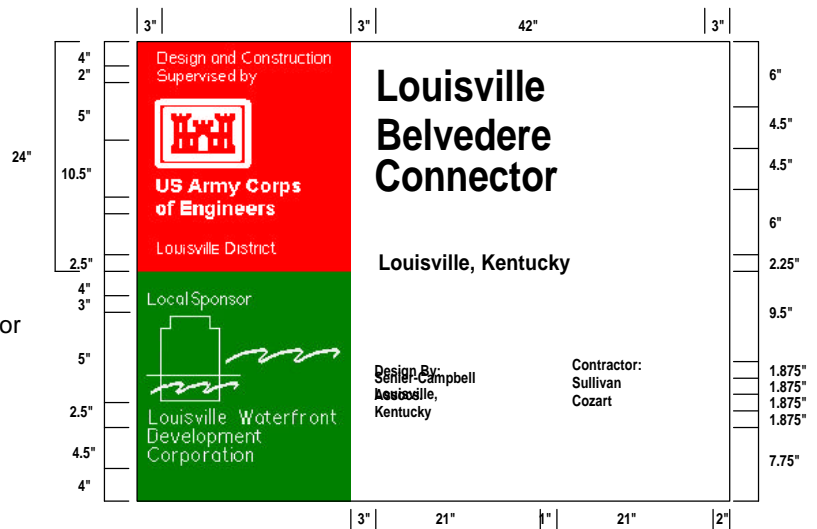
general contractor, etc.) corporate or firm name, city, state.

Color: Black

Typeface: 1.25" Helvetica Regular

Maximum line length: 21"

Sponsor  
Logo

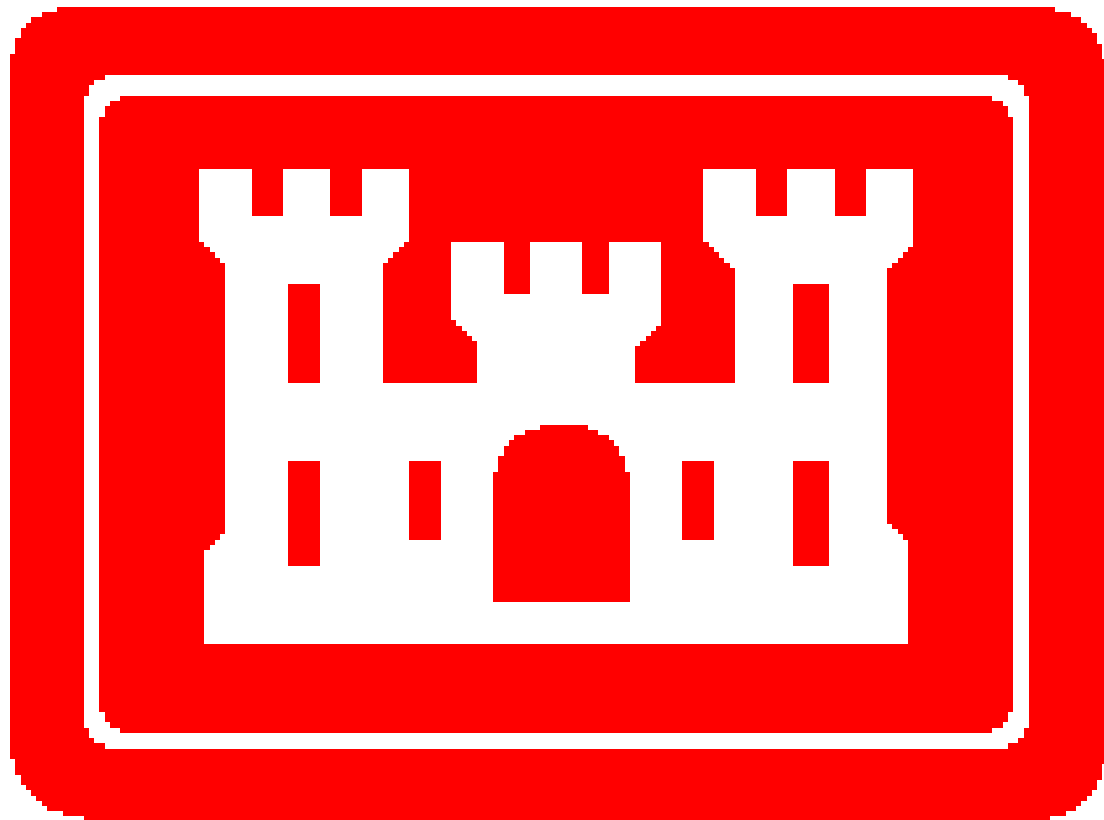


Legend Size	Panel Size	Post Size	Mounting Height	Color Bkg/Lgd
Various	4'x6'	4"x4"	48"	WH-DR/BK

All typography is flush left and rag right, upper and lower case with initial capitals only as shown.







**US Army Corps  
of Engineers  
Louisville District**

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE <i>(Read instructions on the reverse side prior to initiating this form)</i>					DATE		TRANSMITTAL NO.		
SECTION I - REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS <i>(This section will be initiated by the contractor)</i>									
TO:			FROM:		CONTRACT NO.		CHECK ONE: <input type="checkbox"/> THIS IS A NEW TRANSMITTAL <input type="checkbox"/> THIS IS A RESUBMITTAL OF TRANSMITTAL _____		
SPECIFICATION SEC. NO. <i>(Cover only one section with each transmittal)</i>			PROJECT TITLE AND LOCATION				CHECK ONE: THIS TRANSMITTAL IS FOR FIO <input type="checkbox"/> GOV'T <input type="checkbox"/> APPROVAL		
ITEM NO.	DESCRIPTION OF ITEM SUBMITTED <i>(Type size, model number/etc.)</i>		MFG OR CONTR. CAT., CURVE DRAWING OR BROCHURE NO. <i>(See Instruction no. 8)</i>	NO. OF COPIES	CONTRACT REFERENCE DOCUMENT		FOR CONTRACTOR USE CODE	VARIATION <i>(See instruction no. 6)</i>	FOR CE USE CODE
a.	b.		c.	d.	e.	f.	g.	h.	i.
REMARKS					I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as other wise stated  <div>NAME AND SIGNATURE OF CONTRACTOR</div>				
SECTION II - APPROVAL ACTION									
ENCLOSURES RETURNED <i>(List by Item No.)</i>			NAME, TITLE AND SIGNATURE OF APPROVING AUTHORITY				DATE		

## Instructions

1. Section I will be initiated by the contractor in the required number of copies.
2. Each transmittal shall be numbered consecutively in the space provided for "Transmittal No.". This number, in addition to the contract number, will form a serial number for identifying each submittal. For new submittals or resubmittals mark the appropriate box; in resubmittals, insert transmittal number of last submission as well as the new submittal number.
3. The "Item No." will be the same "Item No." as indicated on ENG FORM 4288-R for each entry on this form.
5. Separate transmittal form will be used for submittals under separate section of the specifications.
6. a check shall be placed in the "Variation" column when a submittal is not in accordance with the plans and specifications—also, a written statement to that effect shall be included in the space provided for "Remarks."
7. Form is self-transmittal, letter of transmittal is not required.
8. When a sample of material or Manufacturer's Certificate of Compliance is transmitted, indicate "Sample" or "Certificate" in column c, Section I.
9. U.S. Army Corps of Engineers approving authority will assign action codes as indicated below in space provided in Section I column i to each item submitted. In addition they will ensure enclosures are indicated and attached to the form prior to return to the contractor. The Contractor will assign action codes as indicated below in Section I, column g. to each item submitted.

### THE FOLLOWING ACTION CODES ARE GIVEN TO ITEMS SUBMITTED

- A – Approved as submitted.
  - B – Approved, except as noted on drawings.
  - C – Approved, except as noted on drawings. Refer to attached sheet resubmission required.
  - D – Will be returned by separate correspondence.
  - E – Disapproved (See attached).
  - F – Receipt acknowledged.
  - FX – Receipt acknowledged, does not comply as noted with contract requirements.
  - G – Other (*Specify*)
10. Approval of items does not relieve the contractor from complying with all the requirements of the contract plans and specifications.

*(Reverse of ENG form 4025-R)*

## EQUIPMENT-IN-PLACE LIST

Contract No. \_\_\_\_\_

Description of Item: \_\_\_\_\_

Model No: \_\_\_\_\_

Serial No: \_\_\_\_\_

Capacity: \_\_\_\_\_

Name of Mfg: \_\_\_\_\_

Condition: \_\_\_\_\_

Checked by: \_\_\_\_\_ Replacement Cost \_\_\_\_\_

Description of Item: \_\_\_\_\_

Model No: \_\_\_\_\_

Serial No: \_\_\_\_\_

Capacity: \_\_\_\_\_

Name of Mfg: \_\_\_\_\_

Condition: \_\_\_\_\_

Checked by: \_\_\_\_\_ Replacement Cost \_\_\_\_\_

Description of Item: \_\_\_\_\_

Model No: \_\_\_\_\_

Serial No: \_\_\_\_\_

Capacity: \_\_\_\_\_

Name of Mfg: \_\_\_\_\_

Condition: \_\_\_\_\_

Checked by: \_\_\_\_\_ Replacement Cost \_\_\_\_\_

DEFICIENCY LIST

CONTRACT NUMBER: \_\_\_\_\_PROJECT: \_\_\_\_\_

DEFICIENCYCORRECTION						
DEFIC. NO.	DESCRIPTION	DATE OBSERVED	CQC REPORT NO.	DATE CORRECTED	CQC REPORT NO.	COMMENTS

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VEHICLE MAINTENANCE SHOPS  
PHASE 2  
626TH FSB AND 86TH CSH  
FORT CAMPBELL, KENTUCKY  
PN 43962 FY98

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## SECTION C-01330

### SUBMITTAL PROCEDURES

#### PART 1 GENERAL

##### 1.1 SUBMITTAL IDENTIFICATION

Submittals required are identified by SD numbers as follows:

###### SD-01 Data

Submittals which provide calculations, descriptions, or documentation regarding the work.

###### SD-04 Drawings

Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, details of fabrication, layouts of particular elements, connections, and other relational aspects of the work.

###### SD-06 Instructions

Preprinted material describing installation of a product, system or material, including special notices and material safety data sheets, if any, concerning impedances, hazards, and safety precautions.

###### SD-07 Schedules

Tabular lists showing location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

###### SD-08 Statements

A document, required of the Contractor, or through the Contractor, from a supplier, installer, manufacturer, or other lower tier Contractor, the purpose of which is to confirm the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other verifications of quality.

###### SD-09 Reports

Reports of inspections or tests, including analysis and interpretation of test results.

###### SD-13 Certificates

Statement signed by an official authorized to certify on behalf of the manufacturer of a product, system or material, attesting that the product, system or material meets specified requirements. The statement must be dated after the award of the contract, must state the Contractor's name and address, must name the project and location, and must list the specific requirements which are being certified.

###### SD-14 Samples

Samples, including both fabricated and unfabricated physical examples of materials, products, and units of work as complete units or as portions of units of work.

###### SD-18 Records

Documentation to record compliance with technical or administrative requirements.

#### SD-19 Operation and Maintenance Manuals

Data which forms a part of an operation and maintenance manual.

Submittal Description definitions are not included in Paragraph 1.1, SUBMITTAL IDENTIFICATION, since they are primarily for the guidance of project specification writers. A listing of SD numbers and titles is included in Paragraph 1.1 to accommodate the production of the SPECSINTACT submittal verification report.

The SD numbers and names, have been assigned by the SPECSINTACT Configuration, Control and Coordinating Board, and they correspond to the terminology used in the technical sections. These numbers and names should not be changed.

### 1.2 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

#### 1.2.1 Government Approved

Governmental approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings."

#### 1.2.2 Information Only

All submittals not requiring Government approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

#### 1.2.3 Review of Construction Contractor Submittals

All submittals for Government Approval will also contain one of the following designations, "D1", "D2", "D3", or "X", in the remarks column of Form 4288. All submittals "For Information Only" will also contain a "C" or "E" in the remarks column.

D1 - A Contractor design in which the project designer maintains final and total responsibility for the design.

D2 - A Contractor design in which the design liability is passed to the Contractor.

D3 - Fire Protection/Life Safety Submittals (excluding sprinkler design).

X - Any other submittal for which Government Approval is desired.

C - Information for CEORLRL purposes.

E - Information for CEORLRL purposes.

### 1.3 APPROVED SUBMITTALS

The Contracting Officer's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the CQC requirements of this contract is responsible for

dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

#### 1.4 DISAPPROVED SUBMITTALS

The Contractor shall make all corrections required by the Contracting Officer and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, a notice in accordance with the Contract Clause "Changes" shall be given promptly to the Contracting Officer.

#### 1.5 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

#### PART 2 PRODUCTS (Not Applicable)

#### PART 3 EXECUTION

##### 3.1 GENERAL

The Contractor shall submit all items listed on the Submittal Register or specified in other sections of these specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor's Quality Control (CQC) representative and each item shall be stamped, signed, and dated by the CQC representative indicating action taken. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Submittals requiring Government approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon completion of the work shall be picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

##### 3.2 SUBMITTAL REGISTER (ENG FORM 4288)

At the end of SPECIAL CONTRACT REQUIREMENTS, Section H, is one set of ENG Form 4288 (Submittal Register) listing items of equipment and materials for which submittals are required by the specifications. Columns "c" through "p" have been completed by the Government; the Contractor shall complete columns "a", "b" and "q" through "v" and return three hard copies to the Contracting Officer for approval within 30 calendar days after Notice to Proceed for approval. The approved submittal register will become the scheduling document and will be used to control submittals throughout the life of the contract. The submittal register and the progress schedules shall be coordinated. NOTE: The Contractor is required to add additional entries to the Submittal Register for all items requiring multiple submittals, including Formwork Shop Drawings per Lift, Concrete Reinforcement per Lift, Concrete Lift Drawings per Lift, Multiple Shop Assembly Drawings, etc. These entries should be made prior to original

submission of the Submittal Register within 30 days of Notice to Proceed. Copies of updated or corrected listing shall be submitted to the Contracting Officer at least every 60 days in the quantity specified.

### 3.3 SCHEDULING

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (a minimum of 30 calendar days exclusive of mailing time) shall be allowed and shown on the register for review and approval. No delay damages or time extensions will be allowed for time lost in late submittals. An additional 30 calendar days shall be allowed and shown on the register for review and approval of submittals for refrigeration and HVAC control systems.

### 3.4 ALL SUBMITTALS WHICH EXCEEDS THE DETAIL SHOWN ON THE CONTRACT DRAWINGS

3.4.1 Special Contract Requirements 9, AS-BUILT DRAWINGS, also require submittal details or drawings which exceed that which is shown on the contract drawings to be transmitted in electronic format. All such submittals must include, along with the hard copy of the drawings required above, CADD files of the submittal in Microstation format, for incorporating into as-built or record drawings.

3.4.2 These submittals include those that reflect structural details, foundation layouts, equipment, sizes, mechanical room layouts, and other similar data, including all extensions of design, which were not shown or have changed from the original drawings.

3.4.3 Submittals requiring electronic transmission in addition to the normal submittal are indicated in the Submittal Register. The designation "CADD" will be shown in the "REMARKS" column.

### 3.5 TRANSMITTAL FORM (ENG FORM 4025)

The sample transmittal form (ENG Form 4025) attached at the end of Section H shall be used for submitting both Government approved and information only submittals in accordance with the instructions on the reverse side of the form. These forms will be furnished to the Contractor. This form shall be properly completed by filling out all the heading blank spaces and identifying each item submitted. Special care shall be exercised to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item.

### 3.6 SUBMITTAL PROCEDURE

Submittals shall be made as follows:

#### 3.6.1 Procedures

The Contractor shall submit to the Contracting Officer eight (8) copies of all submittals of items requiring shop inspection and six (6) copies of all other submittals as called for under the various headings of these specifications.

#### 3.6.2 Deviations

For submittals which include proposed deviations requested by the Contractor, the column "variation" of ENG Form 4025 shall be checked. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

### 3.7 CONTROL OF SUBMITTALS

The Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

### 3.8 GOVERNMENT APPROVED SUBMITTALS

Upon completion of review of submittals requiring Government approval, the submittals will be identified as having received approval by being so stamped and dated. Three copies of the submittal will be retained by the Contracting Officer and three copies of the submittal will be returned to the Contractor.

### 3.9 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

### 3.10 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements shall be similar to the following:

CONTRACTOR (Firm Name)	
_____	Approved
_____	Approved with corrections as noted on submittal data and/or sheet(s).
SIGNATURE: _____	
TITLE: _____	
DATE: _____	

--END OF SECTION--

## SECTION C-01451

### CONTRACTOR QUALITY CONTROL

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3740 (1994a) Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

ASTM E 329 (1995b) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

##### 1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program, and all costs associated therewith shall be included in the applicable unit prices or lump-sum prices contained in the Bidding Schedule.

#### PART 2 PRODUCTS (Not Applicable)

#### PART 3 EXECUTION

##### 3.1 GENERAL

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause entitled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence. The project superintendent will be held responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with quality requirements specified in the contract. The project superintendent in this context shall mean the individual with the responsibility for the overall management of the project including quality and production.

##### 3.2 QUALITY CONTROL PLAN

###### 3.2.1 General

The Contractor shall furnish for review by the Government, not later than 30 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause entitled "Inspection of Construction." The plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used. The Government will consider an interim plan for the first 30 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be

permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started.

### 3.2.2 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC System Manager who shall report to the project superintendent.

b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters will also be furnished to the Government.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section C-01330 SUBMITTAL PROCEDURES.

e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities will be approved by the Contracting Officer.)

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.

h. Reporting procedures, including proposed reporting formats.

i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks and has separate control requirements. It could be identified by different trades or disciplines, or it could be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable feature under a particular section. This list will be agreed upon during the coordination meeting.

### 3.2.3 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

#### 3.2.4 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

#### 3.3 COORDINATION MEETING

After the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, the Contractor shall meet with the Contracting Officer or Authorized Representative and discuss the Contractor's quality control system. The CQC Plan shall be submitted for review a minimum of 30 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the Contractor and the Contracting Officer. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

##### 3.3.1 Subcontractor CQC Orientation

Before a Subcontractor begins work on the job site, the CQC System Manager will train the Subcontractor by showing the video tape entitled "CQC" - - A Bridge (or Pathway) to Success" and answering any questions pertaining to quality control operations. This requirement is waived only if a Subcontractor attended the initial coordination meeting described above. A copy of this video can be borrowed from the Contracting Officer. A record of the orientation shall be documented in the QC Report.

#### 3.4 QUALITY CONTROL ORGANIZATION

##### 3.4.1 General

The requirements for the CQC organization are a CQC System Manager and sufficient number of additional qualified personnel to ensure contract compliance. The Contractor shall provide a CQC organization which shall be at the site at all times during progress of the work and with complete authority to take any action necessary to ensure compliance with the contract. All CQC staff members shall be subject to acceptance by the Contracting Officer.

##### 3.4.2 CQC System Manager

The Contractor shall identify as CQC System Manager an individual within his organization at the site of the work who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a construction person with a minimum of 10 years in related work. This CQC System Manager shall be on the site at all times during construction and will be employed by the prime Contractor. The CQC System Manager shall be assigned no other duties. An alternate for the CQC System Manager will be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate will be the same as for the designated CQC System Manager.

##### 3.4.3 CQC Personnel

In addition to CQC personnel specified elsewhere in the contract, the Contractor shall provide as part of the CQC organization specialized personnel to assist the



CQC System Manager for the following areas: electrical, mechanical, civil/architectural. These individuals shall be employed by the prime Contractor or the subcontractor responsible for the specific work areas of responsibility; be responsible to the CQC System Manager; be physically present at the construction site during work on their areas of responsibility; have the necessary education and/or experience in accordance with the experience matrix listed herein. These individuals shall have no other duties other than quality control.

#### Experience Matrix

<u>Area</u>	<u>Qualifications</u>
a. Civil/Architectural	Graduate Civil Engineer with 2 years experience in the type of work being performed on this project or technician with 5 yrs. related experience.
b. Mechanical	Graduate Mechanical Engineer with 2 yrs. experience or person with 5 yrs. related experience.
c. Electrical	Graduate Electrical Engineer with 2 yrs. related experience or person with 5 yrs. related experience.

#### 3.4.4 Additional Requirement

In addition to the above experience and education requirements, the CQC System Manager and the alternate CQC Systems Manager shall have completed the course entitled "Construction Quality Management For Contractors". This course is periodically offered through Associated Builders and Contractors, Inc. or Associated General Contractors, Inc.

#### 3.4.5 Organizational Changes

The Contractor shall maintain his CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

#### 3.5 SUBMITTALS

Submittals shall be made as specified in Section C-01330 SUBMITTAL PROCEDURES. The CQC organization shall be responsible for certifying that all submittals are in compliance with the contract requirements.

#### 3.6 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of work as follows:

##### 3.6.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

- a. A review of each paragraph of applicable specifications.
- b. A review of the contract drawings.
- c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.
- d. Review of provisions that have been made to provide required control inspection and testing.
- e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.
- f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.
- g. A review of the appropriate activity hazard analysis to assure safety requirements are met.
- h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.
- i. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.
- j. Resolve all differences.
- k. Discussion of the initial control phase.
- l. The Government shall be notified at least 24 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

### 3.6.2 Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

- a. A check of work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.
- b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.
- c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.
- d. Resolve all differences.
- e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.
- f. The Government shall be notified at least 24 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the daily CQC report. Exact location of initial

phase shall be indicated for future reference and comparison with follow-up phases.

g. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

### 3.6.3 Follow-up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. The Contractor shall not build upon or conceal non-conforming work.

### 3.6.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same definable features of work if the quality of on-going work is unacceptable, if there are changes in the applicable CQC staff, onsite production supervision or work crew, if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

## 3.7 TESTS

### 3.7.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a Corps of Engineers approved testing laboratory or establish an approved testing laboratory at the project site. The Contractor shall perform the following activities and record and provide the following data:

- a. Verify that testing procedures comply with contract requirements.
- b. Verify that facilities and testing equipment are available and comply with testing standards.
- c. Check test instrument calibration data against certified standards.
- d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
- e. Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test will be given. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility will be provided directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

### 3.7.2 Testing Laboratories

#### 3.7.2.1 Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329.

#### 3.7.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Contractor will be assessed a charge of \$1,375.00 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

#### 3.7.3 On-Site Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

#### 3.7.4 Furnishing or Transportation of Samples for Testing

Costs incidental to the transportation of samples or materials will be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Government shall be delivered to the Corps of Engineers Division Laboratory, f.o.b., at the following address:

11275 Sebring Drive  
Cincinnati, (Forest Park), Ohio 45240-2714

Coordination for each specific test, exact delivery location, and dates will be made through the Area Office.

### 3.8 COMPLETION INSPECTION

#### 3.8.1 Punch-Out Inspection

Near the completion of all work or any increment thereof established by a completion time stated in the Special Clause entitled "Commencement, Prosecution, and Completion of Work," or stated elsewhere in the specifications, the CQC System Manager shall conduct an inspection of the work and develop a punch list of items which do not conform to the approved drawings and specifications. Such a list of deficiencies shall be included in the CQC documentation, as required by paragraph DOCUMENTATION below, and shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

#### 3.8.2 Pre-Final Inspection

At the completion of all work or any increment thereof established by a completion time stated in the Special Clause entitled "Commencement, Prosecution, and Completion of Work," or stated elsewhere in the specifications, the CQC System Manager shall conduct an inspection of the work and develop a "punch list" of items which do not conform to the approved drawings and specifications. Such a list of deficiencies shall be included in the CQC documentation, as required by paragraph DOCUMENTATION below, and shall include the estimated date by which the deficiencies will be corrected. Once this is accomplished the Contractor shall notify the Government that the facility is complete and is ready for the Government's "Prefinal" inspection. The Government will perform this inspection to verify that the facility is complete and ready to be occupied. A Government

"Prefinal Punch List" will be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected and so notify the Government so that a "Final" inspection with the customer can be scheduled. Any items noted on the "Final" inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph will be accomplished within the time slated for completion of the entire work or any particular increment thereof if the project is divided into increments by separate completion dates.

### 3.8.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, his superintendent or other primary management person and the contracting Officer's representative will be in attendance at this inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups, and major commands may also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon notice from the Contractor. This notice will be given to the Contracting Officer at least 14 days prior to the final acceptance inspection and must include the Contractor's assurance that all specific items previously identified to the Contractor as being acceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause entitled "Inspection of Construction".

### 3.9 DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

- a. Contractor/subcontractor and their area of responsibility.
- b. Operating plant/equipment with hours worked, idle, or down for repair.
- c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.
- d. Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.
- e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.
- f. Submittals reviewed, with contract reference, by whom, and action taken.
- g. Off-site surveillance activities, including actions taken.
- h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
- i. Instructions given/received and conflicts in plans and/or specifications.
- j. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Government daily within 20 hours after the date(s) covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every seven days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

1. Deficiency Tracking System. The Contractor shall maintain a cumulative list of deficiencies identified for the duration of the project. Deficiencies to be listed include those failures, Government oral observations and Notifications of Noncompliance. The list shall be maintained at the project site. Copies of updated listings shall be submitted to the Government at least every 30 days.

### 3.10 SAMPLE FORMS

Sample forms for Daily Construction Quality Control Report and Deficiency list are enclosed at the end of Section H.

### 3.11 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the worksite, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

-- End of Section --

# **SAFETY PAYS**

## **SECTION C-01560**

### **ENVIRONMENT PROTECTION**

7/98

#### **PART 1 GENERAL**

##### **1.1 SUMMARY (Not Applicable)**

##### **1.2 SUBMITTALS**

The following shall be submitted in accordance with Section C-01300 SUBMITTAL PROCEDURES:

###### **1.2.1 SD-8, Statements**

Work Plans; GA.

###### **1.2.1.1 Environment Protection & Storm Water Pollution Prevention**

Prior to commencement of work at the site, the Contractor will submit within 10 calendar days after Notice to Proceed, his written detailed proposal for implementing the requirements for environmental pollution control specified herein. The contractor will then meet the representatives of the Contracting Officer upon their completion of review of his proposal as needed for compliance with the environmental pollution control program.

###### **1.2.1.2 Preconstruction Survey**

Prior to start of any onsite construction activities, the Contractor and the Contracting Officer shall make a joint condition survey, after which the Contractor shall prepare a brief report indicating on a layout plan the condition of trees, shrubs, and grassed areas immediately adjacent to the site of the work and adjacent to his assigned storage area and access routes(s) as applicable. This report will be signed by both the Contracting Officer and Contractor upon mutual agreement as to its accuracy and completeness.

###### **1.2.1.3 Waste Disposal Scheme**

As part of his proposed implementation under Paragraph 3.2, and prior to onsite construction, the Contractor shall submit a description of his scheme for disposing of waste materials resulting from the work under this contract. If any waste material is dumped in unauthorized areas, the Contractor shall remove the material and restore the area to the condition of the adjacent undisturbed areas. Where directed, contaminated ground shall be excavated, disposed of as approved, and replaced with suitable fill material, all at the expense of the Contractor.

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### **PART 2 POLLUTION PREVENTION PLANS**

#### **2.1 ENVIRONMENTAL PROTECTION REQUIREMENTS**

Provide and maintain, during the life of the contract, environmental protection as defined. Plan for and provide environmental protective measures to control pollution that develops during normal construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Comply with all Federal, State, and local regulations.

##### **2.1.1 Environmental Protection Plan**

The contractor will develop a site specific Environmental Protection Plan which will address in detail the following:

###### **a. Hazardous materials (HM) to be brought onto the post:**

Any hazardous materials planned or used on the post will be included in the post Hazardous Materials Tracking Program maintained by the Safety Department. A hazardous material as per 29 CFR 1910.1200 is any material which is a physical or health hazard. The Contractor shall complete the FTCKY HAZMAT inventory form which appears as an appendix to this section. The inventory form requires a list (including quantities) of HM to be brought to the post and copies of the corresponding material safety sheets (MSDS). The completed form shall be submitted to the Contracting Office representative and to Fort Campbell DPW Environmental - Pollution Prevention Branch. In the event the usage of additional Hazardous Materials are found necessary during the project, they will be included into the MSDS package of the Environmental Protection Plan. At project completion, any hazardous material brought onto the post shall be removed from the site by the Contractor. As required by the Emergency Planning and Community Right - to - Know Act (EPCRA), the Contractor will account for the quantity of HM brought to the post, the quantity used or expended during the job, and the leftover quantity which (1) may have additional useful life as HM and shall be removed by the Contractor, or (2) may be hazardous waste, which shall then be removed as specified herein. This information will be maintained monthly and provided to PWBC as required.

###### **b. Hazardous waste (HW) generated:**

The Environmental Protection Plan must list, quantify explain how any HW generated during the project will be disposed. Disposal of hazardous waste generated by the contractor shall be disposed off site according to applicable regulations at the contractor's expense. A report must be submitted annually of the generation of hazardous waste on post and must be provided to the Contracting Officer representative and



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to PWBC Environmental - Pollution Prevention Branch.

c. Storage of hazardous waste:

In accordance with post regulations and 40 CFR 262, hazardous waste shall be stored near the point of generation up to a total quantity of (one quart) 1 L of acutely hazardous waste or (55 gallons) 200 L of hazardous waste (Satellite Accumulation Point). Any volume exceeding these quantities shall be moved to a HW permitted area within 3 days. Locations of hazardous waste storage areas must be approved by PWBC-ED-PP. Containers must be labeled in accordance with 40 CFR 262 and must contain the words Hazardous Waste or other words which identify the contents of the container. Prior to shipment of hazardous waste on site or off, the waste must be placed into good condition Department of Transportation (DOT) specification containers for hazardous waste (49 CFR 172.101). The area selected for the storage of hazardous wastes must minimize the threat to human health or the environment in the event of a release.

d. Minimization of hazardous waste:

In accordance with post regulations, the Contractor should substitute materials as necessary to reduce the generation of HW and include a statement to that effect in the Environmental Plan.

e. Environmental conditions likely to be encountered during this project:

Contact the Contracting officer for conditions in the area of the project which may be subject to special environmental procedures. Include this information in the Preconstruction Survey. Describe in the Environmental Plan any permits required prior to working the area, and contingency plans in case an unexpected environmental condition is discovered.

f. Permitting plans for any transportation and disposal, excavation, or construction of hazardous waste that will require an environmental permit from an issuing agency:

The Contractor is responsible for generating the permits and delivering the completed documents to the Contracting Officer. The Contracting Officer will review the permits and the Contractor shall file the documents with the appropriate agency and complete disposal with the approval of the Contracting Officer. Correspondence with the State concerning the environmental permits and completed permits shall be delivered to the Contracting Officer.

g. Radon mitigation design and testing

All residential and non residential construction performed at Fort Campbell must have radon mitigation features implemented into the design. The contractor will install preliminary features as per details

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contained in the mechanical and structural drawings. The contractor will hire an independent testing company to perform radon monitoring prior to inhabitation of the building. The firm must be EPA accredited and approved to perform work in the State of Tennessee. A list of accredited testing firms in the state of TN can be obtained through the state Radon Program Coordinator (615)532-0733. In the event radon concentrations greater than 4 pCi/l (pico curies per liter ) are revealed consult Fort Campbell PWBC through the Contracting Officer's representative for guidance pertaining to retesting. If upon further testing unacceptable levels are present, additional mitigation features will be installed followed by more testing. The building will not be inhabited until levels of less than 4 pCi/l have been achieved.

h. Air Quality - The contractor will complete and submit to the Contracting Officer's Representative specific information pertaining to air pollutants from both process and nonprocess sources (if applicable). Examples of non process sources consist of boilers, hot water heaters and high pressure washers . Checklist for non-process sources and vent /stack appear at the end of the specification.. Specific process checklist for the following specific source equipment/ techniques must be obtained through the contracting officer's representative.

- Cyclone/Woodworking operations
- Storage tanks
- Spray booths
- Solvent Waste collection systems
- Sandblasting operations
- Plastic molding operations
- Lamination processes
- Degreasing units
- Aggregate handling & storage piles & haul roads
- Control devices/ techniques

These forms must be completed and submitted prior to the installation or construction of any equipment which requires permitting.

### **2.1.1.1 Environmental Protection Plan Format**

The Environmental Protection Plan shall follow the following format:

1. Hazardous materials to be brought onto the post
2. MSDS package
3. Employee training documentation

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4. HW storage plan
5. HW to be generated
6. Preconstruction survey results
7. Permitting requirements identified
8. Waste Disposal Plan
9. Site Specific Spill Contingency Plan

### 2.1.1.2 Environmental Plan Review

Fourteen days after the environmental protection meeting, submit to the Contracting Officer the proposed environmental plan for further discussion, review, and approval.

### 2.1.1.3 Commencement of the Work

As directed by the Contracting Officer, following approval.

### 2.1.2 Storm Water Pollution Prevention Plan

The contractor will develop a site specific Storm Water Pollution Prevention Plan for the construction activities to be performed at the site.

The following Pollution Prevention Plan is incorporated into the contract documents as a portion of the construction activities to be undertaken by the contractor. The plan as outlined below contains the minimum requirements for the work under this contract. Actual field conditions may dictate a requirement by the contracting officer for additional measures to fulfill this requirement.

## **POLLUTION PREVENTION PLAN**

Purpose of Plan - To control sediment in the storm water runoff coming from the drainage area in and around the construction site.

Project Location: Fort Campbell Army Base

FortCampbell, Kentucky

Vehicle Maintenance (Phase II)

Latitude - 36°38'30"

Longitude - 87°28'30"

(Values approximate for Latitude and longitude)

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Constructed by: U.S. Army Corps of Engineers  
Louisville District P.O. Box 59  
Louisville, KY 40201-0059

Description of Site and Construction Activity: This construction activity consists of the building the second phases of the Vehicle Maintenance Shops and associated parking. The total construction area is approximately 14.7 acres. All runoff from the disturbed area will be routed through a sediment control structure. The soil disturbing activity will consist of clearing and grubbing for installing the erosion and sediment control features, excavating for new storm sewers (catch basins ditches and outfalls), sanitary sewers, underground utilities, parking areas and the building foundation. The erosion and sediment controls being utilized include, temporary gravel construction entrance/exit, inlet protection for existing and new catch basins, sediment trap, rock check dam, silt fence with rock overflows and permanent seeding and mulching. Some temporary seeding may be needed if there will be no construction activity in disturbed areas for more than 14 days.

Runoff Coefficient: Post construction runoff coefficient for the disturbed area will change significantly from 0.5 under present conditions to 0.9 when construction is complete.

Receiving Waters: All runoff coming from disturbed areas will be diverted so that it passes through a sediment control structure, and into the storm drainage system and into Dry Fork Creek.

Storm Water Management: During construction storm water runoff will pass through a sediment control structure. Upon project completion all accumulated sediment will be taken to an approved location as directed by the contracting officer.

Controls:

Erosion and Sediment Controls

STABILIZATION PRACTICES	STRUCTURAL PRACTICES
Permanent Seeding	Temporary Gravel Construction Entrance/Exit

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Temporary Seeding	Silt Fence with rock Overflow
Mulching	Rock Check Dam
	Temporary Diversion
	Rock Dam/Sediment Trap
	Inlet Protection: Gravel Donut
	Fabric

### **2.2 ANTICIPATED SEQUENCE OF ACTIVITIES:**

Place erosion control measures in locations that are in close proximity to those shown on the drawings. Additional erosion control measures may be required to comply with the NPDES once construction begins. Any changes to the plan as herein described, will require an amendment.

Surface water flowing towards the construction area will be diverted around the disturbed areas to reduce the erosion potential. Silt Fences, Rock Check Dam, Sediment Trap and Inlet Protection shall be properly constructed to detain runoff and trap sediment.

Construct new amenities including utilities, building, parking areas and sidewalks.

Landscape and grade remaining areas according to the drawings.

Upon completion of the project, remove all the temporary controls and take any sediment that is removed to a site designated by the contracting officer. Any areas disturbed by the removal of the temporary controls shall be seeded and mulched within 24 hours.

NOTE: The contractor controls the actual sequence, however, the sediment controls must be established prior to initiation of work in any area.

### **2.3 DEMONSTRATION OF COMPLIANCE WITH FEDERAL, STATE AND LOCAL REGULATIONS**

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All activities conducted under this contract will be performed in accordance with Federal, State and local regulations. The construction contractor's specifications require compliance with all applicable regulations.

### **2.4 POLLUTION PREVENTION PLAN AND NOTICE OF INTENT**

The contractor will implement the Pollution Prevention Plan (PPP) as shown on the plans and directed in these specifications. This plan must be implemented in accordance with the NPDES permit. A notice of Intent (NOI) will be prepared by the U.S. Army Corps of Engineers and submitted to the State of Tennessee fourteen days prior to the notice to proceed being issued. The contractor must sign the NOI contractor consent form for Tennessee. A blank form is attached at the end of this section. The contractor shall maintain a copy of the PPP in their construction trailer. Any changes made to the plan must be documented and approved by the Contracting Officer.

### **2.5 INVENTORY FOR POLLUTION PREVENTION PLAN**

The materials or substances listed below are expected to be present onsite during construction: These are examples of materials that could be Hazardous Materials and an inventory must be kept using Fort Campbell's Hazardous Materials Form (Hazardous Materials Inventory Form) attached. This list is not comprehensive but for illustration only. The contractor must maintain and update their Hazardous Materials list and inventory forms.

- |                            |                           |                     |
|----------------------------|---------------------------|---------------------|
| - Concrete                 | - Fertilizer              | - Detergents        |
| - Petroleum Based Products | - Paints (enamel & latex) | - Cleaning Solvents |
| - Metal Rebar              | - Wood                    | - Sealant           |
| - Concrete Additives       | - Tar                     | - Asphalt           |
| - Structural Steel         |                           |                     |

### **2.6 SPILL PREVENTION**

The following are the material management practices to reduce the risk of spills or other accidental exposure of materials and substances to storm water runoff.

#### **2.6.1 Good Housekeeping**

- a. An effort will be made to store only enough product required to perform the task. Storage shall meet Federal, State, and local regulations to include 150% containment of bulk storage over 19 liters.

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- b. All materials stored onsite will be stored in a neat and orderly manner in their appropriate containers. When possible material should be stored under a roof or in an enclosed area. If this is not possible material will be covered with a tarpaulin or suitable replacement to prevent direct contact between storm water and the materials. All runoff from the storage area will be routed through a control structure.
- c. Products will be kept in their original containers with the original manufacture's label.
- d. Substances will not be mixed with one another unless recommended by the manufacturer.
- e. Whenever possible, all of the product will be used up before disposing of container.
- f. Manufactures' recommendations for proper use and disposal will be dictated by Federal, State and local regulations. Manufactures' recommendations for proper use and disposal will be followed if they are more stringent than Federal, State or local requirements.
- g. The contractor will conduct daily inspections to ensure proper use and disposal of materials onsite.

### **2.6.2 Hazardous Products:**

These practices are used to reduce the risks associated with hazardous materials and must be incorporated into the Pollution Prevention Plan:

- a. Products will be kept in their original containers unless they are not resealable.
- b. Original labels and material safety data will be retained; they contain important product information.
- c. All containers will have the Diamond label affixed per the National Fire Prevention Association's Publication 704.
- d. Disposal of surplus product will be done as recommended by the manufacturers' or as required by State and local regulations.

### **2.7 SPILL PREVENTION PRACTICES**

In addition to good housekeeping and material management practices discussed in the previous sections of this plan, a Site Specific Spill Contingency Plan (SSSCP) must be prepared by the contractor and

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submitted to Fort Campbell Environmental Division. The SSSCP must be developed as outlined in the Fort Campbell Environmental Handbook. Guidance and instructions for preparation of the SSSCP are included at the end of this section. In addition to the requirements of the SSSCP, the following practices must be followed for spill prevention and cleanup:

- a. Materials and equipment necessary for cleanup will be kept in the material storage area. There will be enough equipment to supply at least three men. Equipment and materials will include but not be limited to; brooms, dust pans, mops, rags, gloves, goggles, absorbing compound such as kitty litter, saw dust, sand, etc. and plastic and metal trash containers specifically for this purpose.
- b. Manufacturers' recommended methods for spill cleanup will be clearly posted and site personnel will be made aware of the procedures and the location of information and cleanup supplies.
- c. All spills will be cleaned up immediately after discovery.
- d. The spill area will be kept well ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with a hazardous substance.
- e. All spills of toxic or hazardous materials will be reported to the appropriate State or local government agency.
- f. Once a spill has occurred, the spill prevention plan will be adjusted to include measures to prevent this type of spill from recurring with a discussion of the appropriate cleanup for that type of spill. A description of the spill, what caused it and the cleanup measures utilized will be included.
- g. The prime contractor will be responsible for the day-to-day site operations, including spill prevention and will designate an employee by name to be the primary cleanup coordinator. Each subcontractor bringing more than 25 gallons or 150 pounds of a spillable substance shall also designate a cleanup coordinator. The cleanup coordinators will designate three additional site personnel for spill prevention and cleanup. Everyone designated will be trained in spill prevention and cleanup.

### **2.8 SPILL PLANNING AND RESPONSE TRAINING REQUIREMENTS**

1. All personnel involved with the management and handling of oil and hazardous materials must be



## **SAFETY PAYS**

periodically trained in spill prevention and response. The training will be similar to the Hazardous Communication Program B Worker Right to Know and will include the following key features:

- a. Health effects of exposure to oil or hazardous materials;
- b. Applicable first aid procedures to be used following exposure;
- c. Personal Protective Equipment requirements and procedures for using equipment;
- d. Evacuation procedures;
- e. Spill material combustibility and potential for flash-back along vapor trails;
- f. Fire fighting procedures and special hazards of combustible products;
- g. Reactivity of spill material with common materials including water;
- h. Use and maintenance of all alarms and monitoring equipment associated with spill prevention or response;
- i. Initial Notification procedures;
- j. Site specific contingency plans;
- k. Location of posted Site Specific Spill Contingency Plan;
- l. Immediate spill response actions including location of pump controls and valves to stop spill flow; location and use of fire extinguishers, absorbents, neutralizing agents and other immediate spill response procedures;
- m. Visual inspections requirements of the particular areas; and
- n. Purpose and requirements of good housekeeping.

2) Spill response training exercises will be conducted once per year for personnel working at oil and hazardous material sites. Personnel entering one of these positions will be trained within two weeks after

## **SAFETY PAYS**

starting work and after any significant changes to the spill plan or training program. Records of the type, extent, and frequency of each individual=s training will be maintained until closure of the applicable area or until three years after the date the individual last worked in the area.

### **2.9 SPILL REPORTING**

a) The first action to be taken in the event of a spill is to report the spill. If you observe a release of a hazardous material, report it to your supervisor and the Fire Department. The Fire Department will notify PWBC Environmental Division and if required, Installation Safety, Emergency Medical and Preventative Medicine. The PWBC Environmental Division does all reporting to State/Federal Agencies.

a. The Fire Department must be promptly notified of any of the following spills:

1. Any uncontrolled quantity of a hazardous substance, or if assistance is needed by Fire Department or Environmental Division, or as instructed by the MSDS or supervisor=s discretion.

### **2.10 PRODUCT SPECIFIC PRACTICES**

The following product specific practices will be followed on-site:

#### **2.10.1 Petroleum Products:**

All vehicles will be periodically inspected for leaks and shall receive regular preventative maintenance to reduce the chance of leaks occurring. Petroleum products will be stored in tightly sealed containers that are clearly labeled. Bulk storage areas will be equipped with secondary containment appropriate for risk of loss from the primary container(s). Storage shall meet Federal, State, and local regulations. Secondary containment shall hold 150% of the bulk amount stored over 5 gallons. The contractor will maintain a specific spill contingency and countermeasures plan for the bulk storage area.

#### **2.10.2 Fertilizer:**

Fertilizers used will be applied only in the minimum amounts recommended by the manufacturer. Once applied, fertilizer will be worked into the soil to limit exposure to storm water. The contents of any partially used bags of fertilizer will be transferred to a sealable container to avoid spills.

#### **2.10.3 Paints, Solvents, and Sealant:**

## **SAFETY PAYS**

All containers will be tightly sealed and in the storage area when not being used. Excess materials will not be discharged into the storm sewer system but will be properly disposed of according to manufacturers' instructions or state and local regulations.

### **2.10.4 Concrete Trucks:**

Concrete trucks will be allowed to wash out, discharge surplus concrete and drum wash water only in a designated area. All wash water from the concrete trucks must be retained onsite and treated according to state and local regulations. Upon completion of the job all discharges of surplus concrete and any soil contaminated by the concrete wash water will be removed from the site and taken to an approved disposal area. Water with the potential of entering sinkholes or storm sewers will not be allowed to be discharged.

### **2.11 WASTE DISPOSAL:**

**Waste Material** - All waste material will be collected and disposed of at an approved site during construction. No construction waste materials will be buried on site. All personnel involved with waste material disposal will be instructed on the correct procedures for waste disposal. Notices stating these procedures will be posted in the office trailer and the contractor's quality assurance designee will be responsible for seeing that these procedures are followed.

**Hazardous Waste** - Any hazardous waste generated or encountered onsite will be disposed of in the manner specified by local or state regulations or as recommended by the manufacturer. Site personnel will be instructed in the disposal of hazardous waste and the procedures will be posted. The quality assurance designee will be responsible for seeing that the proper procedures are carried out.

**Sanitary Waste** - All sanitary waste will be collected from the portable units a minimum of once per week by a licensed sanitary waste management contractor serving Fort Campbell.

### **2.12 OFFSITE VEHICLE TRACKING**

A stabilized construction entrance is provided to help prevent vehicle tracking of sediments off site. The contractor will be responsible for cleaning the roads daily to remove any excess mud, dirt, or rock deposited by the vehicle traffic. Dump trucks used to carry excavated material will be checked prior to exiting the site for large amounts of soil accumulations on the wheels and chassis.

## **SAFETY PAYS**

### **2.13 INSTALLATION/CONSTRUCTION**

#### **2.13.1 Temporary Gravel Construction Entrance/Exit:**

- a. Avoid locating on steep slope or at curves in public roads.
- b. Remove all vegetation and other objectionable material from the foundation area, and grade and crown for positive drainage.
- c. If slope towards the road exceeds 2%, construct a 6-inch to 8 inch high water bar with 3:1 side slopes across the foundation area about 15 feet from the entrance diverting runoff from the road.
- d. Install pipe under the pad if needed to maintain proper public road drainage.
- e. If wet conditions are anticipated, place geotextile fabric on the graded foundation to improve stability.
- f. Place stone to dimensions shown on design detail #1.
- g. Divert all surface runoff and drainage from the stone pad to a sediment control structure.

#### **2.13.2 Temporary Seeding:**

- a. Test soil to determine its nutrient level or apply a 12-12-12 fertilizer at a rate of 400 to 600 pounds per acre.
- b. Work fertilizer into the soil 2 to 4 inches deep with a disk or rake operated across the slope.
- c. Select a seed mixture and application rate appropriate for this site. Consult the county SWCD office for assistance.
- d. Apply seed uniformly with a drill or cultipacker seeder, or by broadcasting, and cover to recommended depth.
- e. If drilling or broadcasting, firm the seedbed with a roller or cultipacker.
- f. Mulch seeded area to increase seeding success.

## **SAFETY PAYS**

### **2.13.3 Permanent Seeding:**

- a. Test soil to determine pH and nutrient levels and apply any lime or fertilizer recommended for the type seed being used. Consult the county SWCD office for assistance.
- b. Till the soil to obtain a uniform seedbed, working the fertilizer and lime into the soil 2 to 4 inches deep with a rake operated across the slope.
- c. Select a seeding mixture and application rate appropriate for this site. Consult the county SWCD office for assistance. Type of seed should be based on site condition, soil pH, intended land use and expected level of maintenance.
- d. Apply seed evenly with a drill or cultipacker seeded or by broadcasting and cover to a depth of 1/4 to 1/2 inches.
- e. If drilling or broadcasting, firm the seedbed with a roller or cultipacker.
- f. Mulch all seeded areas. Note: If seeding is done with a hydroseeder, fertilizer and mulch can be applied with the seed in a slurry mixture.

### **2.13.4 Mulching:**

- a. Apply at the rate recommended.
- b. Spread uniformly with no more that 25% of the ground surface visible.
- c. If straw or hay is used it must be anchored immediately.

### **2.13.5 Silt Fence and Rock Overflow:**

- a. Prepare an access route to the fence to provide for cleanout.
- b. Along the entire intended fence line, dig a 8-inch deep flat-bottomed or V-shaped trench.
- c. On the down slope side of the trench, drive the wood or steel support posts into the ground as shown on design detail #2, with a maximum spacing of 8 feet if fence is supported by wire or 6 feet if extra strength fabric is used with no wire support.

## SAFETY PAYS

- d. Fasten support wire (if used) to the up slope side of the post and extend it 8-inches into the trench.
- e. Run a continuous length of geotextile fabric in front of the support wire and posts, avoiding joints, particularly at any low points in the fence line.
- f. Fabric may be of a woven or non-woven type with filtering efficiency and tensile strength and containing UV inhibitors and stabilizers to ensure 6 month minimum life at temperatures 0 to 120 degrees Fahrenheit.

MINIMUM SPECIFICATIONS FOR SILT FENCE FABRIC		
Physical Property	Woven Fabric	Non-Woven Fabric
Filtering Efficiency	85%	85%
<b>Tensile Strength at Strength at 20% elongation:</b>		
Standard Strength *	30 lbs./linear in.	50 lbs./linear in.
Extra Strength	50 lbs./linear in.	70 lbs./linear in.
Slurry Flow Rate	0.3 gal./min./sq.ft.	4.5 gal./min./sq.ft.
Water Flow Rate	15 gal./min./sq.ft.	220 gal./min./sq.ft.
UV Resistance	70%	85%

- \* If using standard strength fabric a 14 gauge, 6-inch mesh wire fence is needed for support.
- g. If joint is necessary, nail the overlap to the nearest post with lath.

## SAFETY PAYS

- h. Place bottom 12-inches of the fabric in the 8-inch deep trench, extending the remaining 4-inches towards the up slope side.
- i. Backfill the trench with compacted earth or gravel.
- j. If using a pre-packed commercial silt fence, follow manufacture's installation instructions.
- k. Typical silt fence design is shown on design detail #2.
- l. Silt fence rock overflow is shown on design detail #3.

### 2.13.6 Rock Check Dam:

- a. Excavate a cutoff trench into the creek banks, and extend it a minimum of 18 inches into the abutment.
- b. Place the rock in the cutoff trench and channel as shown in detail #4. Maximum height of dam is 2 feet with a minimum of 9 inches between top of dam and top of banks.
- c. If more than one dam is used in the drainage way then place riprap downstream of the lower most dam a distance of 6 feet.

### 2.13.7 Temporary Diversion:

- a. Mark diversion location.
- a.** Mark diversion location. **a.** Mark diversion location.
- b. Clear and Grub along alignment.
- c. Set grade and alignment to fit site needs and topography, maintaining a stable positive grade towards the outlet, and realigning or elevating the ridge as needed to avoid reverse grades.
- d. Construct the diversion to dimensions and grades shown on detail #5.  
Build the ridge higher than designed and compact using the wheels of the construction equipment.
- e. Leave sufficient area along the diversion to permit clean-out and regrading.
- f. Vegetate and mulch the ridge immediately after construction.

### 2.13.8 Rock Dam/Sediment Trap:

- a. The area under the embankment shall be cleared, grubbed and stripped of any vegetation and root mat. The pool area shall be cleared.
- b. Excavate a cutoff trench into the creek banks, and extend it a minimum of 18 inches into the abutments and fill with compacted earth fill.

## **SAFETY PAYS**

### 2.13.9 Inlet Protection:

#### Fabric Drop Inlet Protection:

- a. Construct a dike on the downslope side of the inlet to prevent runoff from bypassing. Dike should be 6-inches higher than inlet protection.
- b. Cut fabric from a single roll to avoid joints.
- c. Construct the fence as shown on Design Detail #7.
- d. Space the support posts evenly against the inlet perimeter a maximum of 3 feet apart, and drive them about 1.5 feet into the ground.

#### Gravel Donut Inlet Protection:

- a. Construct a dike on the downslope side of the inlet to prevent runoff from bypassing. Dike should be 6 inches higher than inlet protection.
- b. Construct the inlet protection as shown on Design Detail #8.

### 2.14 INSPECTION AND MAINTENANCE

#### .14 INSPECTION AND MAINTENANCE.14 INSPECTION AND MAINTENANCE

The contractor will be required to inspect all erosion and sediment control practices being used and performs required maintenance as outlined in the following sub-paragraphs. All controls will be inspected a minimum of once each week and after any storm event that produces 2 inch of rain or more. Once a problem is found or sediment has reached the clean-out elevation, corrective action shall commence within 24 hours. Inspections shall continue until the controls are removed or the vegetative cover is firmly established. The contractor will designate a minimum of two employees who will be responsible for inspection and maintenance, and filling out inspection reports. The contractor will be required to train those employees that are selected so that they are well versed in the inspection and maintenance practices for keeping the erosion and sediment controls used in good working order.

#### 2.14.1 Temporary Gravel Construction Entrance/Exit Pad:



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- a. Reshape pad as needed for drainage and runoff control.
- b. Topdress with clean stone as needed.
- c. Immediately remove mud and sediment tracked or washed onto public roads by brushing or sweeping. Flushing can only be used if the water is conveyed into a sediment basin.
- d. Repair any broken road pavement immediately.

### **2.14.2 Temporary Seeding:**

- a. Inspect to see if vegetative stands are adequately established; re-seed if necessary.
- b. Check for erosion damage and repair; re-seed and mulch if necessary.

### **2.14.3 Permanent Seeding:**

- a. Inspect until the stand of grass is successfully established.
- b. Repair damaged, bare or sparse areas by filling any gullies, re-fertilizing, overseeding or re-seeding, and mulching.
- c. If cover is sparse or patchy, review seed type chosen, soil fertility, moisture conditions, and mulching; then repair the affected area either by over-seeding or by reseeded and mulching after re-preparing the seedbed.
- d. If vegetation fails to grow, additional soil testing will be needed and the SWCD office will need to be consulted.
- e. Add additional fertilizer based on soil testing results.

### **2.14.4 Mulching:**

- a. If washout, breakage, or erosion is present, repair the surface, then re-seed, re-mulch.

### **2.14.5 Silt Fence and Rock Overflow:**

## **SAFETY PAYS**

- a. Inspect for fabric tears, start of decomposition, or any other problem that can render the fence ineffective, and replace the effected portion.
- b. Remove deposited sediment when it reaches half the height of the fence at its lowest point or is causing the fabric to bulge.
- c. During clean-out be careful to not undermine the fence.
- d. Remove deposited sediment from behind the rock overflow when it reaches half the height of the rock overflow.

### **2.14.6 Rock Check Dam**

- a. Inspect channel between dams and downstream of lower most dam for erosion. Place channel lining as needed.
- b. Remove accumulated sediment behind dam as needed to maintain channel capacity.
- c. Add rock to dam as needed to maintain design height and cross-section.
- d. When dams are no longer needed, remove the rock and stabilize channel, using channel lining if necessary

### **2.14.7 Temporary Diversion**

- a. Inspect for sediment accumulation in the channel and reinforce the ridge as needed.
- b. Remove sediment from the channel and regrade as needed to ensure proper drainage.

### **2.14.8 Rock Dam/Sediment Trap**

- a. Inspect the rock dam and basin after each storm event.
- b. Remove sediment when it accumulates to half the design volume.
- c. Check the dam and abutments for erosion, piping, or rock displacement, and repair immediately.
- d. If the basin does not drain between storms, replace the stone on the upstream face of the dam.

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e. If the basin drains too rapidly following a storm, add additional gravel to the upstream face of the dam.

f. Once the contributing drainage area has been stabilized, remove the accumulated sediment from the basin, remove the dam, disposing of the rock in designated disposal areas, and smooth the site to blend with the surrounding area.

### **2.14.9 Inlet Protection:**

#### **Fabric Drop Inlet Protection:**

- a. Inspect fabric after each storm and make necessary repairs.
- b. Remove sediment from the pool area after each storm to provide storage for the next storm. Avoid damaging or undercutting fabric during sediment removal.
- c. When contributing drainage area has been stabilized, remove and properly dispose of all construction material and sediment, grade the area to the elevation of the top of the inlet, and then stabilize.

### **2.14.10 Gravel Donut Inlet Protection:**

- a. Remove sediment after each storm and make needed repairs.
- b. When the contributing drainage area has been stabilized, remove and dispose of any unstable sediment and construction material, and re-stabilize.

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### **PART 3 EXECUTION**

#### **3.1 GENERAL**

The Contractor shall perform all work in such manner as to minimize the pollution of air, water, or land, and shall, within reasonable limits, control noise and the disposal of solid waste materials, as well as other pollutants. Information contained Section 02050 Demolition should also be referenced:

#### **3.2 IMPLEMENTATION**

Within 10 calendar days after Notice to Proceed and prior to commencement of the work at the site, the Contractor shall meet the representatives of the Contracting Officer to review and alter his proposal as needed for compliance with the environmental pollution control program.

#### **3.3 PROTECTION OF LAND AREAS**

Except for any work on storage areas and access routes specifically assigned for the use of the Contractor under this contract, the land areas outside the limits of permanent work performed under this contract shall, in accordance with CONTRACT CLAUSE: PROTECTION OF EXISTING VEGETATION, STRUCTURE, UTILITIES AND IMPROVEMENTS, be preserved in their present condition. Contractor shall confine his construction activities to areas defined for work on the plans or specifically assigned for his use. In accordance with CONTRACT CLAUSE: OPERATIONS AND STORAGE AREAS, storage and related areas and access routes required temporarily by the Contractor in the performance of the work will be assigned by the Contracting Officer. No other areas on Government premises shall be used by the Contractor without written consent of the Contracting Officer.

#### **3.4 PROTECTION OF TREES AND SHRUBS**

CONTRACT CLAUSE: PROTECTION OF EXISTING VEGETATION, STRUCTURES, UTILITIES AND IMPROVEMENTS, is hereby supplemented as follows: The Contractor shall not deface, injure or

## **SAFETY PAYS**

destroy trees or shrubs, nor remove or cut them without special authority. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage.

### **3.4.1 Tree Protective Structures**

Where, in the opinion of the Contracting Officer, trees may possibly be defaced, bruised, injured or otherwise damaged by the Contractor's equipment or by his other operations, he may direct the Contractor to provide temporary protection of such trees by placing boards, plans, or poles around them.

### **3.4.2 Restoration of Damaged Trees**

Any tree scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the Contractor's expense. All scars made on trees not designated on the plans to be removed by construction operations shall be coated as soon as possible with an approved tree wound dressing. Trees that are to remain, either within or outside established clearing limits, that are damaged by the Contractor beyond saving in the opinion of the Contracting Officer, will be immediately removed, if so directed, and replaced with a nursery-grown tree of the same species and size.

## **3.5 PROTECTION OF WATER RESOURCES**

The Contractor shall control the disposal of fuels, oils, bitumens, calcium chloride, acids, or harmful materials, both on and off the Government premises, and shall comply with applicable Federal, State, County and Municipal laws concerning pollution of rivers and streams while performing work under this contract. The contractor should note that the entire cantonment area is within the delineated Well Head Protection Area for Fort Campbell. This means any release in this area has the potential, due to the installations geological features to impact their drinking water source. For this reason special measures need to be taken to prevent chemicals, fuels, oils, greases, bituminous materials, herbicides and insecticides from entering public waters or potentially migrating via sinkholes or other karst related geologic features to drinking water sources. Special measures will include the generation of a site-specific Spill Contingency Plan (form attached). Water used in onsite material processing, concrete curing, foundation and concrete cleanup, and other waste waters shall not be allowed to reenter a stream if an increase in the turbidity of the stream could result therefrom.

## **3.6 BURNING**

Air pollution restrictions applicable to this project are as follows. Materials shall not be burned on the Government premises. If the Contractor elects to dispose of waste materials off the Government premises, by burning, he shall make his own arrangements for such burning area and shall, as specified in

## **SAFETY PAYS**

CONTRACT CLAUSE: PERMITS AND RESPONSIBILITIES, conform to all local regulations.

### **3.7 DUST CONTROL**

The Contractor shall maintain all excavations, stockpiles, access roads, waste areas, and all other work areas free from excess dust to such reasonable degree as to avoid causing a hazard or nuisance to the using service or to others. Approved temporary methods consisting of sprinkling, chemical treatment, or similar methods will be permitted to control dust. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs.

### **3.8 EROSION CONTROL**

Surface drainage from cuts and fills within the construction limits, whether or not completed, and from borrow and waste disposal areas, shall be graded to control erosion within acceptable limits. Temporary control measures shall be provided and maintained until permanent drainage facilities are completed and operative. The area of bare soil exposed at any one time by construction operations should be held to a minimum.

### **3.9 CORRECTIVE ACTION**

The Contractor shall, upon receipt of a notice in writing of any noncompliance with the foregoing provisions, take immediate corrective action. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs of damages by the Contractor unless it was later determined that the Contractor was in compliance.

### **3.10 POST-CONSTRUCTION CLEANUP OR OBLITERATION**

In accordance with CONTRACT CLAUSE: CLEANING UP, the Contractor shall, unless other wise instructed in writing by the Contracting Officer, obliterate all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed areas shall be graded and filled and the entire area seeded.

### **3.11 PAYMENT**

## **SAFETY PAYS**

No separate payment or direct payment will be made for the cost of the work covered under this section, and such work will be considered as a subsidiary obligation of the Contractor.

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**HAZARDOUS MATERIAL INVENTORY FORM**



**SAFETY PAYS**

**SITE SPECIFIC SPILL CONTINGENCY PLAN**

C-01560-27

**SAFETY PAYS**

**CONTRACTOR'S SIGNATURE FORM**

## **SAFETY PAYS**

## **AIR PERMIT CHECKLISTS**

**SAFETY PAYS**

**-- End of Section --**



# **SAFETY PAYS**

Site Specific Spill Contingency Plan

Fort Campbell Environmental Handbook Chapter 17

1 August 1986

**SITE SPECIFIC SPILL CONTINGENCY PLAN**

UNIT NAME: \_\_\_\_\_

**NOTE:** Refer to Chapter 17 of the Environmental Handbook prior to completing this form. This site specific spill plan requires yearly updating. General office and office cleaning supplies are excluded from this spill planning requirement. Refer to Chapter 9 of the Environmental Handbook Hazardous Communication Training Program for handling instructions for these items.

**1. RESPONSIBLE PERSONS**

**A. PRIMARY PERSON**

Name: \_\_\_\_\_ Rank: \_\_\_\_\_  
 Work Phone: \_\_\_\_\_ Home Phone: \_\_\_\_\_

**B. ALTERNATE PERSON**

Name: \_\_\_\_\_ Rank: \_\_\_\_\_  
 Work Phone: \_\_\_\_\_ Home Phone: \_\_\_\_\_

**C. SECOND ALTERNATE PERSON**

Name: \_\_\_\_\_ Rank: \_\_\_\_\_  
 Work Phone: \_\_\_\_\_ Home Phone: \_\_\_\_\_

**2. SPECIAL PRECAUTIONARY MEASURES FOR BUILDING(S) AND ASSOCIATED AREAS**

If more than two buildings, fill out another site specific spill plan form for those buildings.

Building # \_\_\_\_\_ Building # \_\_\_\_\_  
 \_\_\_\_\_

**A. Avoid contact with spilled substances.**

**B. Refer to Material Safety Data Sheets (MSDS) for particular hazards and precautionary measures for special handling and spill procedures. Flammable materials will be extinguished as to local fire regulations and the material safety data sheets. If needed, list any materials that need special handling, PPE or special precautionary measures.**

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**3. PROBABLE SPILL ROUTES**

(Write description of spill route or show on item 6 sketch.)

Check here if not applicable ☐Are probable spill routes shown on the sketch? ☐ a

No

Building # \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Building # \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**4. EMERGENCY SPILL EQUIPMENT ON HAND**

(For example, sweeping compound and absorbent material, brooms and plastic dust pans, emergency spill kits, non-sparking shovels, other items as needed and required)

Bldg #: \_\_\_\_\_

\_\_\_\_\_

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Bldg #: \_\_\_\_\_

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\_\_\_\_\_

**5. HAZARDOUS MATERIAL AND QUANTITY NORMALLY ON HAND****A.** Attach a listing of Hazardous Materials on hand, using the Fort Campbell Hazardous Materials Inventory form found in Chapter 9 of the Fort Campbell Environmental Handbook.**B.** Material Safety Data Sheets are readily available and located at (the specific location is required).

Bldg #: \_\_\_\_\_

Bldg #: \_\_\_\_\_



## **6. BUILDING(S) AND ASSOCIATED AREA(S) LAYOUT DIAGRAM**

Attach a hand sketched drawing of the building layout and associated areas indicating building number, location of MSDSs, hazardous materials, spill response materials and equipment, and evacuation routes. Copies of the site specific spill plan shall be placed in the buildings to which they refer to inform personnel of appropriate actions in the event of a spill.

## **7. FIELD TRAINING EXERCISES (FTX) PLANNING** (Reference FM 10-69)

Unit personnel deploying to the field must be briefed on field spill planning prior to deployment by the Responsible Persons above or designee. The briefing will include procedure, type of terrain, materials that could spill, spill equipment available and location.

## **8. SPILL RESPONSE AND NOTIFICATION PROCEDURES**

### **A. REPORT THE SPILL.**

The first action in the event of a spill is to report the spill. If you observe a release of a hazardous material, report it to your supervisor and the Fire Department as required below. If the spill is in a Training Area, then the spill will be reported to Range Control, who will then notify the Fire Department. The Fire Department will notify DPW Environmental Division and, if required, Installation Safety, Emergency Medical, and Preventative Medicine. The DPW Environmental Division does all reporting to State/Federal Agencies.

The Fire Department (or Range Control) must be promptly notified of any of the following spills:

- Any uncontrolled quantity of a hazardous substance, or if assistance is needed by Fire Department or Environmental Division, or as instructed by the MSDS or supervisor's discretion;
- Oil and other petroleum products with quantity exceeding 10 gallons or area of spill greater than two feet in any direction or any amount that is spilled into a stream or body of water.
- Environmental Division review has determined the material(s) listed require special reporting at the quantity shown: (To be supplied by Environmental staff during plan review )

Name: \_\_\_\_\_ Quantity \_\_\_\_\_  
Name: \_\_\_\_\_ Quantity \_\_\_\_\_  
Name: \_\_\_\_\_ Quantity \_\_\_\_\_

Signature of Environmental Division staff: \_\_\_\_\_

### **SUPERVISOR**

NAME: \_\_\_\_\_ RANK: \_\_\_\_\_  
WORK PHONE: \_\_\_\_\_ HOME PHONE: \_\_\_\_\_

**FIRE DEPARTMENT:** 911 or (from 798: x17, 7171 or 7172) or 431-3471

**RANGE CONTROL:** 798-3001 or 798-4122 or on radio frequency FM 49.95.

**DPW-ENVIRONMENTAL:** 798-3105, 798-9784

If required by your Commanding Officer, additional people to be notified within your chain of command:  
If not required, fill in N/A.

### **ALTERNATE PERSON**

NAME: \_\_\_\_\_ RANK: \_\_\_\_\_  
WORK PHONE: \_\_\_\_\_ HOME PHONE: \_\_\_\_\_

### **ALTERNATE PERSON**

NAME: \_\_\_\_\_ RANK: \_\_\_\_\_

WORK PHONE: \_\_\_\_\_ HOME PHONE: \_\_\_\_\_

The spill report must include the following information:

- Name/Phone/Unit of individual reporting the spill; \_\_\_\_\_
- Location of Spill (Building Number, etc.); \_\_\_\_\_
- Name of spilled material; \_\_\_\_\_
- Amount spilled; \_\_\_\_\_
- Rate currently spilling; \_\_\_\_\_
- Extent of spill, including drainage features; \_\_\_\_\_
- Injuries, if any; \_\_\_\_\_
- Time spill occurred; \_\_\_\_\_
- Any additional information. \_\_\_\_\_

#### **B. STOP OR CONTAIN THE SPILL.**

Assess the situation before attempting to contain any hazardous material spilled and proceed only if it is safe to do so. You must have knowledge of the spilled substance and don any required personal protective equipment. If necessary, make the spill scene off limits to any unauthorized personnel. If situation warrants, evacuate the area.

#### **C. CLEAN UP THE SPILL.**

Under no circumstances should untrained and/or ill equipped persons attempt to perform cleanup. In some instances, spill cleanup may require respiratory protection and other personal protective equipment. If it is within the capability of the unit that caused the spill, then that unit is responsible for its cleanup. DPW Environmental Division will make the decision to obtain assistance and coordinate with other units as required.

If you handle/work with the hazardous material as part of your job, you are to be trained and qualified to participate in the clean up of the spill.

#### **D. DISPOSE OF SPILLED HAZARDOUS MATERIAL.**

All spilled material and other contaminated material (soil, gravel, absorbents, etc.) must be properly disposed. It is the responsibility of the unit that created the spill to properly package and dispose of the waste. DPW Environmental Division will determine the required disposal method.

\_\_\_\_\_

# **SAFETY PAYS**

Contractor's Signature Form

## Construction Activity Storm Water Permitting Requirements

### Contractor's Signature Form

State of Tennessee/Department of Environment and Conservation/Division of Water Pollution Control/Rule 1200-4-10-05

To be completed by developer:

Developer Name: \_\_\_\_\_  
NOI Submission Date: \_\_\_\_\_  
Project Name: \_\_\_\_\_  
Project Location: \_\_\_\_\_ County

To be completed by Contractor:

I have agreed to perform construction-related professional services, described as

that will likely impact the nature of storm water runoff from the named construction activity. Erosion control services involve primarily:

- ☐ Prepare erosion control plan ☐ Inspection of controls  
☐ Install, maintain erosion and sediment controls ☐ Other \_\_\_\_\_

I understand the terms and conditions of Rule 1200-4-10-05 and that I, and my company, as the case may be, are responsible for and legally liable for complying with this Rule and the applicable State and Federal laws. I understand that State or EPA or private actions may be taken against me if the terms and conditions of the Rule are not met.

Printed Name: \_\_\_\_\_ Title: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Company Name: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Phone No. \_\_\_\_\_

Field Person in Charge: \_\_\_\_\_ Phone No. \_\_\_\_\_

Owner/Developer: I certify that the above has been retained to perform the described construction-related services noted above and as outlined in the referenced NOI.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

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**FORT CAMPBELL ENVIRONMENTAL HANDBOOK**  
Guidance and Instruction  
**SITE SPECIFIC SPILL CONTINGENCY PLAN**

---

1 August 1996

**1. Purpose and Scope:**

To provide guidance and instruction for the development, implementation and review of Site Specific Spill Contingency Plans.

**2. Reference: FM 10-69, for FTX only**

**3. Definitions: None**

**4. General:**

a. A Site Specific Spill Contingency Plan (SSSCP) is required for each area or facility that stores or utilized hazardous materials, including petroleum, oils and lubricants (POL). Each unit will review its plan annually and make required corrections and updates by 01 February. A memorandum will be sent to the Environmental Division stating the review was completed. If changes were made, attach a copy of the updated SSSCP to the memo. A copy of the SSSCP must be provided to the Environmental Division.

b. General office and office cleaning supplies are excluded from this spill planning requirement. Refer to Chapter 9 of the Environmental Handbook, Hazardous Communication Training Program, for handling instructions for these items.

**5. Responsibilities:**

The EQO will ensure that the Plan is made available to all employees, emergency response teams, local emergency personnel and the Environmental Division.

**6. Instruction:**

The Plan will include the following information:

- a. Name and phone number of the Responsible Persons at the unit;
- b. Special precautionary measures for hazardous materials;
- c. Probable spill route;
- d. A list of spill response material/equipment on hand;
- e. A list of each hazardous material and quantity normally on hand. Include the size of the containers and Location of MSDS sheets. Refer to Chapter 9 of this Handbook for more information on MSDS sheets.

f. A building and associated area drawing, indicating location of hazardous materials, spill response material/equipment, evacuation route, spill response, and phone numbers with names of those to be called;

g. Field Training Exercise Spill Planning. Although not required, an FTX Spill Plan can be added to your units SSSCP, or it can be a separate plan. However, unit personnel that deploy to the field must be briefed on field spill planning for the FTX by the Responsible Person or designee. Procedures, type of terrain expected, materials that could spill, spill equipment available and it's location should be included in the briefing. Refer to FM 10-69.

h. Spill Response and Notification Procedures.

i. Spill response equipment is a critical component of an effective response to an unexpected release of hazardous materials. Making an inventory of potential places where releases may occur, and having appropriate and sufficient spill response equipment to deal with those potential releases is required for each unit. Maintaining a list of personnel to call in case of an emergency is of utmost importance in contingency planning.

7. Additional Guidance:

a. Use the Site Specific Spill Contingency Plan "fill-in the blanks form", which follows in this Chapter, to complete your plan.

b. For additional guidance, information, or answers to your questions, contact Mr. Wayne Hinson, Environmental Division, at x9784 or x3105.

c. For future reference, place this document behind *Tab Number 17* in your Fort Campbell Environmental Handbook

## CHECKLIST FOR NON-PROCESS SOURCE

Organizational Owner/Operator: \_\_\_\_\_

Date: \_\_\_\_\_ Interviewer: \_\_\_\_\_

Facility: \_\_\_\_\_ Contact: \_\_\_\_\_ Phone: \_\_\_\_\_

Bldg. No.: \_\_\_\_\_ Room No.: \_\_\_\_\_ Source No.: \_\_\_\_\_

### FOR DPW-E USE ONLY

Permit Status:	<input type="checkbox"/> Required	<input type="checkbox"/> Not Required		
Permit Type:	<input type="checkbox"/> Operating	<input type="checkbox"/> Construction	<input type="checkbox"/> Relocation	<input type="checkbox"/> Modification

### General

1. Description and designation of source (Boiler #1, Hot Water Heater #1, etc.)

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

2. Construction date (manufactured) \_\_\_\_\_ Date commenced operations \_\_\_\_\_  
Installation date (at site) \_\_\_\_\_

3. Manufacturer \_\_\_\_\_  
Model No. \_\_\_\_\_ Serial No. \_\_\_\_\_

4. Normal operating hours \_\_\_\_\_ hrs/day, \_\_\_\_\_ days/week, \_\_\_\_\_ weeks/yr.

5. % operating (time) by calendar year per quarter  
\_\_\_\_\_ 1st \_\_\_\_\_ 2nd \_\_\_\_\_ 3rd \_\_\_\_\_ 4th.

6. Maximum (potential) operating hours  
\_\_\_\_\_ hrs/day, \_\_\_\_\_ days/week, \_\_\_\_\_ weeks/yr.

7. Fuel type: Primary fuel \_\_\_\_\_ Standby fuel (if any) \_\_\_\_\_  
BTU values of fuels: Primary fuel \_\_\_\_\_ Standby fuel (if any) \_\_\_\_\_

8. Primary use of heat source \_\_\_\_\_  
Secondary use of heat source (if any) \_\_\_\_\_

9. If coal burner, type of firing? \_\_\_\_\_

10. Maximum rated boiler horsepower (BHP) \_\_\_\_\_  
Heat input capacity (MMBtu/hr) \_\_\_\_\_  
Maximum rated electrical Output (kw) \_\_\_\_\_ (if applicable)

11. Average % load \_\_\_\_\_ or actual maximum heat input value used \_\_\_\_\_ MMBtu/hr

12. For fuels other than natural or liquified gases:

**CHECKLIST FOR NON-PROCESS SOURCE (continued)**

% Sulfur content \_\_\_\_\_  
% Ash \_\_\_\_\_ (if solid fossil fuel)

13. Average annual fuel consumption: Primary \_\_\_\_\_ (☐ ft<sup>3</sup> ☐ gal - check one)  
Secondary \_\_\_\_\_ (☐ ft<sup>3</sup> ☐ gal - check one)

14. Emissions monitoring equipment installed? ☐ Yes ☐ No

---

(If yes, describe above)

**[ATTACH COMPLETED CONTROL DEVICE(S)/TECHNIQUE(S) CHECKLIST(S)]**

15. Is the source operated under a current operating or construction permit? ☐ Yes ☐ No  
(If yes, obtain copy of permit and attach to this checklist)

16. If fuel oil is used, is the unit served by a fuel storage tank? (check one) ☐ Yes ☐ No  
(If yes, complete and attach Storage Tank Checklist)

17. Is a fuel flow meter installed for  
a. Natural gas (check one): ☐ Yes ☐ No  
b. Other fuel (check one): ☐ Yes ☐ No

**[ATTACH COMPLETED STACK/VENT CHECKLIST FOR NON-PROCESS OPERATION]**

Comments



## VENT/STACK CHECKLIST

Organizational Owner/Operator: \_\_\_\_\_  
Date: \_\_\_\_\_ Interviewer: \_\_\_\_\_  
Facility: \_\_\_\_\_ Contact: \_\_\_\_\_ Phone: \_\_\_\_\_  
Bldg. No.: \_\_\_\_\_ Room No.: \_\_\_\_\_ Source No.: \_\_\_\_\_

---

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### General

1. Description of emission (particulate matter, gaseous, mix, species name, etc.)  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
2. Identify source(s) served \_\_\_\_\_  
\_\_\_\_\_
3. Are the emissions air contaminants? (check one) ☐ Yes ☐ No
4. Does the source also have the potential for fugitive emissions? (check one) ☐ Yes ☐ No  
(If yes, describe nature of fugitive emissions in the comment section.)
5. Has there been a stack test for this source? (check one) ☐ Yes ☐ No  
(If yes, attach copy of stack test documents to this form)
6. Has there been a surrogate stack test for this source? (check one) ☐ Yes ☐ No  
(If yes, attach copy of stack test documents to this form)

### Pick-up Duct Data

1. Hood Type \_\_\_\_\_
2. Hood Dimensions Slot Length \_\_\_\_\_ Slot Width \_\_\_\_\_  
Distance from Hood Face to Contaminant \_\_\_\_\_  
Hood Face Area (Calculated) \_\_\_\_\_  
Measured Air Flow at Hood \_\_\_\_\_  
Measured Face Velocity \_\_\_\_\_  
Hood Static Pressure \_\_\_\_\_  
Duct ID \_\_\_\_\_  
Duct Length to Bldg. Exit \_\_\_\_\_  
Contaminant Capture Temp. \_\_\_\_\_

3. Contaminant Data  
Name \_\_\_\_\_ Constituency Portion \_\_\_\_\_  
(list measurement units)

\_\_\_\_\_  
(LIST ADDITIONAL CONTAMINANTS ON SEPARATE SHEET OR IN COMMENTS)

## VENT/STACK CHECKLIST (continued)

### Vent Information

1. Inside diameter (ID) at exit \_\_\_\_\_ (☐ inches; ☐ ft - check one)
2. Vent height: a. Above ground \_\_\_\_\_ (ft)  
b. Above roof level \_\_\_\_\_ (ft)
3. Gas stream exhaust exit temp \_\_\_\_\_ (☐ °F; ☐ °C - check one)
4. Exit velocity \_\_\_\_\_ (ft/sec), at \_\_\_\_\_ °F, \_\_\_\_\_ (air pressure - note measurement units)  
and standard conditions (68 °F and 1 atm) \_\_\_\_\_ (ft/sec)
5. Exit flow at exit conditions \_\_\_\_\_ (ft<sup>3</sup>/min)  
Obtained from (check one): ☐ calculations ☐ test data  
Exit flow at standard conditions \_\_\_\_\_ (dscfm)
6. Stack gas moisture percent at exit conditions \_\_\_\_\_% ☐ By Weight ☐ Volume (check one)
7. Exit plume direction (check one): ☐ Up ☐ Down ☐ Horizontal
8. Exhaust fan data: horsepower \_\_\_\_\_ RPM \_\_\_\_\_ volume rate \_\_\_\_\_ (ft<sup>3</sup>/min)
9. Air pollution controls installed? (check one) ☐ yes ☐ no  
(If yes, complete and attach Control Device/Technique Checklist)

If the stack/vent serves more than one piece of equipment, submit diagram and identify the units served.  
Complete the additional applicable process or non-process checklists.

### Comments

## SECTION C-01800

### EQUIPMENT OPERATING, MAINTENANCE, AND REPAIR MANUALS

#### PART 1 GENERAL

##### 1.1 SUMMARY (Not Applicable)

##### 1.2 General Requirements

The Contractor shall provide 6 complete copies of the Equipment Operating, Maintenance, and Repair Manuals. Separate manuals shall be provided for each utility system as defined hereinafter. Operations and Maintenance manuals shall be submitted and approved before field training or 90 days before substantial completion (whichever occurs earlier), and as specified in Special Contract Requirement 10. An amount of \$50,000 shall be withheld until submittal and approval of O&M manuals is complete.

##### 1.3 Definitions

###### 1.3.1 Equipment

A single piece of equipment operating alone or in conjunction with other equipment to accomplish a system function.

###### 1.3.2 System

A combination of one or more pieces of equipment which function together to accomplish an intended purpose (i.e. HVAC system is composed of many individual pieces of equipment such as fans, motors, compressors, valves, sensors, relays, etc.)

###### 1.3.3 Hard Cover Binders

The manuals shall be hard cover with posts, or 3-ring binders, so sheets may be substituted easily. The following identification shall be printed on the cover: the words "EQUIPMENT OPERATING, MAINTENANCE, AND REPAIR MANUALS," the project name, building number, and an indication of utility or systems covered, the name of the Contractor, and the Contract number. Manuals shall be approximately 8-1/2 by 11-inches with large sheets folded in and capable of being easily pulled out for reference. All manuals for the project must be similar in appearance, and be of professional quality.

###### 1.3.4 Warning Page

A warning page shall be provided to warn of potential dangers (if they exist, such as high voltage, toxic chemicals, flammable liquids, explosive materials, carcinogens, high pressures, etc.). The warning page shall be placed inside the front cover and in front of the title page. Also, any necessary Material Safety Data Sheets (MSDS) shall be included here.

###### 1.3.5 Title Page

The title page shall include the same information shown on the cover and show the name of the preparing firm and the date of publication.

###### 1.3.6 Table of Contents

Each volume of the set of manuals for this project shall include a table of contents, for the entire set, broken down by volume.

PART 2 PRODUCTS (Not Used.)

PART 3 EXECUTION

3.1 GENERAL

Manuals shall be organized according to the following format, and will include information for each item of equipment (NOTE: This includes any equipment which may have been omitted from the items listed in Paragraph 3.2, System/Equipment Requirements.) A draft outline and table of contents shall be submitted for approval at 50% contract completion.

TABLE OF CONTENTS

PART I. Introduction.

- (a) Equipment Description.
- (b) Functional Description.
- (c) Installation Description.

PART II. Operating Principles.

PART III. Safety.

PART IV. Preventive Maintenance

- (a) Preventive Maintenance Checklist. Lubrication
- (b) Charts and Diagrams.

PART V. Spare Parts Lists

- (a) Troubleshooting Guide
- (b) Adjustments
- (c) Common Repairs and Parts Replacement

PART VI. Illustrations

3.1.1 Part I-Introduction

Part I shall provide an introduction, equipment or system description, functional description and theory of operation, and installation instructions for each piece of equipment. Complete instructions for uncrating, assembly, connection to the power source and pre-operating lubrication shall be included in the installation instructions as applicable. Illustrations, including wiring and cabling diagrams, are required as appropriate in this section. Halftone pictures of the equipment should be included in the introduction and equipment description, as well as system layout drawings with each item of equipment located and marked. Copies of previously submitted shop drawings shall not be used in these manuals.

3.1.2 Part II-Operating Principles

Part II shall provide complete instructions for operating the system, and each piece of equipment. Illustrations, halftone pictures, tables, charts, procedures, and diagrams are required when applicable. This will include step-by-step procedures for start-up and shutdown of both the system and each component piece of equipments, as well as adjustments required to obtain optimum equipment performance, and corrective actions for malfunctions. Performance sheets and graphs showing capacity data, efficiencies, electrical characteristics, pressure drops, and flow rates shall be shown here, also. Marked-up catalogs or catalog pages do not satisfy this requirements.

Performance information shall be presented as concisely as possible and contain only data pertaining to equipment actually installed. Actual test data collected for Contractor performance shall be included here.

### 3.1.3 Part III-Safety

Part III shall contain the general and specific safety requirements peculiar to each item of equipment. Safety information should be repeated as notes cautions, and warnings in other sections where appropriate to operations described.

### 3.1.4 Part IV-Preventive Maintenance

Part IV shall contain a troubleshooting guide, including detailed instructions for all common adjustments and alignment procedures, including a detailed maintenance schedule. Also, include a diagnostic chart showing symptoms and solutions to problems. Include test hookups to determine the cause, special tools and test equipment, and methods for returning the equipment to operating conditions. Information may be in chart form or in tabular format with appropriate headings. Instructions shall be included for the removal, disassembly, repair, reassembly, and replacement of parts and assemblies where applicable and the task is not obvious.

### 3.1.5 Part V-Spare Parts List

Part V shall contain a tabulation of description data and parts location illustrations for all mechanical and electrical parts. The heading of the parts list shall clearly identify the supplier, purchase order number, and equipment. The unit price for each part shall be included, also. Parts shall be listed by major assemblies, and the listing shall be arranged in columnar form. Also, names and addresses of the nearest manufacturer's representatives will be included, as well as any special warranty information. A list of spare parts that are recommended to be kept in stock by the Government installation shall be provided.

### 3.1.6 Part VI-Illustrations

Part VI shall contain assembly drawings for the complete equipment or system and for all major components. Complete wiring diagrams and schematics shall be included. Other illustrations, such as exploded views, block diagrams, and cutaway drawings, are required as appropriate.

### 3.1.7 Framed Instructions

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, including equipment, ductwork, piping valves, dampers, and control sequence, shall be posted at a location near the equipment described. Condensed operating instructions explaining preventive maintenance procedures methods of checking the system for normal safe operation, valve schedule and procedures for safely starting and stopping the system shall be prepared in type form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. Proposed diagrams, instructions, and other sheets shall be submitted prior to posting. The framed instructions shall be posted before field training.

### 3.1.8 Field Training

Contractor shall conduct a training course for the operating staff for each particular system. The training period, a total of 4 hours of normal working time, shall start after the system is functionally completed. The filed instructions shall cover all of the items contained in the Equipment Operating, Maintenance and Repair Manuals. The training will include both classroom and

"hands-on" training. The Contractor shall submit a lesson plan outlining the information to be discussed during training periods. This lesson plan will be submitted 90 days before contract completion and approved before the field training occurs. Training shall be videotaped on one-half inch VHS cassettes and shall be furnished to the Government within ten (10) days following training.

### 3.2 SYSTEM/EQUIPMENT REQUIREMENTS

#### 3.2.1 Facility Heating System

Information shall be provided on the following equipment: boilers, water treatment, chemical feed pumps and tanks, converters, heat exchangers, pumps, unit heaters, fin-tube radiation, air handling units (both heating only and heating and cooling), and valves (associated with heating systems).

#### 3.2.2 Air-Conditioning Systems

Provide information on packaged air-conditioning equipment, water treatment, chemical feed pumps and tanks, air-cooled condensers, pumps, compressors, air handling units, and valves (associated with air-conditioning systems).

#### 3.2.3 Temperature Control and HVAC Distribution Systems

Provide all information described for the following equipment: valves, fans, air handling units, pumps, boilers, converters and heat exchangers, chillers, water cooled condensers, cooling towers, and fin-tube radiation, control air compressors, control components (sensors, controllers, adapters and actuators), and flow measuring equipment.

#### 3.2.4 Heating Plants

Provide the information described for the following equipment: boilers, pumps, fans, chemical feed equipment, control systems, and valves.

#### 3.2.5 Heating Distribution Systems

Provide the information described for the following equipment: valves, fans, pumps, expansion tanks, and piping systems.

#### 3.2.6 Exterior Electrical Systems

Information shall be provided on the following equipment: power transformers, relays, reclosers, breakers, and capacitor bank controls.

#### 3.2.7 Interior Electrical Systems

Information shall be provided on the following equipment: relays, motor control centers, switchgear, solid state circuit breakers, motor controller, EPS lighting systems, wiring diagrams and troubleshooting flow chart on control systems, and special grounding systems.

#### 3.2.8 NOT USED

#### 3.2.9 Domestic Water Systems

The identified information shall be provided on the following equipment: tanks, unit process equipment, pumps, motors, control and monitoring instrumentation, laboratory test equipment, chemical feeders, valves, switching gear, and automatic controls.

3.2.10 NOT USED

3.2.11 Fire Protection Systems

Information shall be provided on the following equipment: alarm valves, manual valves, regulators, foam and gas storage tanks, piping materials, sprinkler heads, nozzles, pumps, and pump drivers.

3.2.12 Fire Detection Systems

The maintenance manual shall include description of maintenance for all equipment, including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

3.2.13 Plumbing Systems

Information shall be provided on the following equipment: water heaters, valves, pressure regulators backflow preventors, piping materials, and plumbing fixtures.

3.2.14 POL Dispensing Systems

Information shall be provided on the following equipment: tanks, automatic valves manual valves, filter separators, pumps, nozzles, meters, controls, and electrical switch gear.

3.2.15 NOT USED

3.2.16 NOT USED

3.2.17 Miscellaneous Systems

Information shall be provided on the following: paging, intercom, air compressors, and other similar type special systems not otherwise specified.

3.2.18 NOT USED

-- End of Section --

## SECTION C-02050

### DEMOLITION

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### ENGINEERING MANUALS (EM)

EM 385-1-1	(1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual
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##### CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
40 CFR 241	Guidelines for the Land Disposal of Solid Wastes
40 CFR 257	Criteria for Classification of Solid Waste Disposal Practices
40 CFR 268	Land Disposal Restrictions
40 CFR 261	Hazardous Waste Identification

##### 1.2 GENERAL REQUIREMENTS

The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Rubbish and other debris will be removed from government property daily, unless otherwise directed to avoid accumulation at the demolition site. The Contractor will dispose of all construction debris in the Woodlawn Road Landfill or the Convenience Center as noted below, unless he has received written permission to do otherwise. Materials that cannot be removed daily will be stored in areas specified by the Contracting Officer. No contractor salvage operations will be allowed. A list of items to be salvaged for the government is provided in paragraph 3.4.1. In the interest of occupational safety and health, the work will be performed in accordance with EM385-1-1, section 23, Demolition and other applicable sections

The contractor will provide written notification to Fort Campbell of specific demolition locations. The notice will be given two (2) weeks prior to demolition activities and will be provided to the Chief of Maintenance, Mrs. Judy Hudson through the Contracting Office representative.

##### 1.3 SUBMITTALS

Government approval is required for SUBMITTALS with a "GA" designation; submittals having an "FIO" designation are for information only. The following will be submitted in accordance with Section C-01300 SUBMITTAL PROCEDURES:

SD-18 Records



Work Plan; GA.

The procedures proposed for the accomplishment of the work will provide for safe conduct of the work, including procedures and methods to provide necessary supports, lateral bracing and shoring when required, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures will include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations in accordance with EM 385-1-1.

#### 1.4 DUST CONTROL

The amount of dust resulting from demolition will be controlled in accordance with TN 1200-3-8-01 (fugitive dust) to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

#### 1.5 PROTECTION

##### 1.5.1 Protection of Personnel

During the demolition work the Contractor will continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, may be allowed to remain standing without additional bracing, shoring, or lateral support until demolished. The Contractor will ensure that no elements determined to be unstable are left unsupported and will be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

##### 1.5.2 Protection of Existing Property

Before beginning any demolition work, the Contractor will survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor will take necessary precautions to avoid damage to existing items to remain in place, items to be reused, or items to remain the property of the Government; any damaged items will be repaired or replaced as approved by the Contracting Officer at no additional cost to the Government. The Contractor will coordinate the work of this section with all other work and will construct and maintain shoring, bracing, and supports as required. The Contractor will ensure that structural elements are not overloaded and will be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

##### 1.5.3 Protection of Trees

Trees within the project site which might be damaged during demolition and which are indicated to be left in place shall be protected by a 2 meter high fence .

The fence will be securely erected to a minimum of 1.5 meters from the trunk of individual trees or follow the outer perimeter of branches for clumps of trees. Any tree designated to remain that is damaged during the work under this contract will be replaced in kind or as approved by the Contracting Officer.

#### 1.5.4 Environmental Protection

The work shall comply with the requirements of section 01560.

#### 1.6 BURNING

The use of burning at Fort Campbell for the disposal of refuse and debris will not be permitted.

#### 1.7 USE OF EXPLOSIVES

The use of explosives will not be permitted.

#### 1.8 MEASUREMENT AND PAYMENT

No separate measurement and payment will be made for the work covered under this section of the specifications but will be considered a subsidiary obligation of the Contractor.

### PART 2 PRODUCTS (Not Applicable)

### PART 3 EXECUTION

#### 3.1 EXISTING STRUCTURES

Existing structures indicated will be removed to 1.0 meter below grade. Sidewalks, curbs, gutters, and street light bases will be removed as indicated.

#### 3.2 UTILITIES

Disconnection of utility services, with related meters and equipment, are specified in the related sections. Existing utilities will be removed as indicated. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer will be notified prior to further work in that area.

#### 3.3 FILLING

Holes, and other hazardous openings will be filled in accordance with Section C-02221 EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS and Section C-02225 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

#### 3.4 DISPOSITION OF MATERIAL

##### 3.4.1 Salvageable Items and Material

Woodlawn Road Landfill will not accept debris contaminated with wood pallets or cardboard and therefore these items must be segregated from debris going to the landfill. The contractor is responsible for separation of these materials or transportation to an off post landfill. The wooden pallets must be transported to Convenience Center #1 located at 11th Street and Stillwell Road (6:00 am -5:00 pm, 7 days a week). The cardboard must be delivered to the Recycle Center (7:30 - 4:00 pm, M-F) or to the Convenience Centers for recovery. The cardboard will include corrugated cardboard, cereal box cardboard and brown paper type.

All scrap metals, nickel/cadmium batteries and lead acid batteries will be delivered to the DRMO for recycling. All deliveries to DRMO must be scheduled in advance and have a completed 1348-1 which can be obtained through the contracting officers representative. The metals can be steel, aluminum, brass, copper and bronze. All materials must be segregated by specific type of metal. Deliveries can be made 7:30 am - 12:00 noon Monday through Thursday. Containers (55 gallon drums, 5 gallon cans, etc.) that have contained petroleum, antifreeze, paint, acid, etc., cannot be accepted as scrap metal at this time. The containers will be emptied of any liquid contents in accordance with applicable regulations and then flattened and placed in dumpsters at the Convenience Centers. Fifty-five gallon drums will be delivered to Pollution Prevention Operations Yard (PPOY) at Wickham and Third.

Small quantities (20 cubic yards) of land clearing and landscaping debris (trees, limbs, stumps, logs, etc.) will be delivered to the Convenience Center at the west end of 11th Street for disposal. For larger quantities, contact PWBC, Environmental Division through the Contracting Office representative. For larger quantities (greater than 20 cubic yards) of land debris, the Contractor will be advised that he will have to mulch the wood and deliver it to a location designated by PWBC, Environmental Division.

Utility poles and other pieces of lumber treated with creosote will be transported by the contractor to Convenience Center #1 located on Stillwell. The contractor will also be responsible for unloading. PWBC will accumulate the materials and salvage if possible or dispose of properly.

Cylinders including aerosol cans, bottles, and tanks used for storing and transporting compressed gases (refrigerants, propane, butane, ether, etc.) will be emptied before disposal. Empty containers will meet the following requirements before disposal. All compressed gas will be removed from the container in accordance with applicable regulations. The container will then be vented prior to being placed in the scrap metals or refuse dumpster. Partially full and reusable containers will be retained by the Contractor.

Questions pertaining to disposal of items listed above or any other items not listed, please contact Fort Campbell PWBC, through the Contracting Office representative.

#### 3.4.2 Historical Items

Historical items will be removed in a manner as to prevent damage. The following historical items will be delivered to the government for deposition: corner stones, contents of corner stones, and document boxes wherever located on site.

#### 3.4.3 Unsalvageable Material

All demolition debris (nonhazardous) will be delivered to the construction/demolition landfill on Woodlawn Road for disposal. Operating hours of the landfill are 7:30 A.M. to 4:00 P.M. (last load will be accepted no later than 3:30 P.M.) Monday through Friday. All debris, with the exception of the materials listed in section 3.4.1, hazardous waste, trees and soil, will be included. For disposal of trees or soil, contact PWBC, Environmental Division through the Contracting Office representative. In the event hazardous waste is found to be present, and not generated by the contractor, contact PWBC through the Contracting Office representative immediately as noted above. The contractor is responsible for the proper disposal of any and all hazardous wastes he generates off site according to Federal, State and local regulations which may apply. Costs of disposal will be the contractor's responsibility.

All wood with the exception of pallets should be delivered to the construction/demolition landfill on Woodlawn Road. If there is an abundance of

useable lumber to be disposed, it will be delivered to DRMO for salvage. The Woodlawn Road Landfill will not accept debris contaminated with wood pallets or cardboard (see paragraph 3.4.1 Salvageable Items and Materials). The Contractor is responsible for separation of these materials or transportation to an off-post landfill.

Hazardous waste, contaminated soil and other special waste not generated by the contractor will be transported to the Pollution Prevention Operations Yard and disposed in accordance with applicable regulations. Contact PWBC, Environmental Division through the Contracting Office representative for instructions. The Contractor is responsible for proper disposal of hazardous waste he generates at Fort Campbell at an approved offsite disposal facility. The Contractor must have the disposal manifest signed by an authorized representative of PWBC, Environmental Division. Documentation of proper disposal must be provided to Fort Campbell PWBC. Hazardous materials partially used and remaining at the end of the contract will be retained by the Contractor and removed from the post.

Excess top soil and excavated materials shall not be mixed and will be transported to the Woodlawn Road Landfill where it will be stockpiled. Temporary stockpiles of gravel and / or sand are only to be located at the construction site only.

Inert materials (clay, top soil, gravel, asphalt, rock, etc.) will be transported to the Woodlawn Road Landfill where it will be stockpiled and disposed as directed by PWBC, Environmental Division. For larger quantities (500 cubic yards or more), contact the PWBC, Environmental Division through the Contracting Office representative.

Scrap rubber with the exception of tires will be delivered to the construction/demolition landfill on Woodlawn Road for disposal. Tires will be delivered to one of the convenience centers for recycling if they were generated by Fort Campbell.

In the event suspect asbestos containing materials are encountered contact PWBC, Environmental Division through the Contracting Office representative.

All unmarked transformers and light ballasts, capacitors and bituminous coatings on underground pipe and tanks, etc. will be assumed to be "PCB-Containing." All PCB containing equipment will be loaded into DOT transferable 55 - gallon drums and delivered to the Pollution Prevention Operations Yard located at Third and Wickham. For handling of marked PCB Free transformers consult the contracting office representative. PWBC Exterior Electric must be notified of any transformer changes or additions. The contractor will be required to insure that the proper decals are placed on the new transformers. This will include decals showing "Non-PCB" and a transformer number.

The Contractor will remove from Fort Campbell the waste created by maintaining his equipment at Fort Campbell (used oil, used antifreeze, contaminated fuel, tires, etc.) and ensure that the waste is disposed in accordance with Federal, State and local regulations. The Contractor will be able, upon request, to show proof of the proper disposal.

Refuse generated on a project site (office waste, lunch bags, etc.) shall be transported to one of the Convenience Centers for disposal.

Dumpsters and compactors located throughout the post are for the convenience of the assigned organizations and are not to be used by the Contractor. The Contractor may make arrangements for dumpster services for their own convenience. No waste is to be brought into Fort Campbell for disposal.

Liquid waste will not be accepted at the Woodlawn Road Landfill. The Contractor will be responsible for the proper disposal of such waste.

Questions pertaining to disposal of items listed above or any other items not listed, please contact Fort Campbell PWBC, through the Contracting Office representative.

#### 3.4 CLEAN UP

Construction debris and rubbish will be removed from the site daily and will not be allowed to accumulate. Debris will be removed and transported in a manner that prevents spillage on streets or adjacent areas. Vehicles used to transport material will be enclosed or have a suitable cover to avoid spills while in transit. Any material which falls from the vehicle while in transit will be cleaned up at the time of spillage. Local regulations regarding hauling and disposal will apply.

-- End of Section --

## SECTION C-02221

### EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2216	(1992) Laboratory Determination of Water (Moisture) Content of Soil, and Rock
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2937	(1994) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1993) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

##### 1.2 DEFINITIONS

###### 1.2.1 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 Test Methods A, B, C and D abbreviated hereinafter as percent laboratory maximum density.

##### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

###### SD-09 Reports

Field Density Tests; FIO. Testing of Backfill Materials; FIO.

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 Satisfactory Materials

Satisfactory materials include materials classified in ASTM D 2487 as GW, GP, SW, GM, GC, SP, SM, SC and CL and shall be free of trash, debris, roots or other organic matter, or stones larger than 3 inches in any dimension.

#### 2.1.2 Unsatisfactory Materials

Unsatisfactory materials include materials classified in ASTM D 2487 as Pt, OH, OL, ML, and MH and any other materials not defined as satisfactory.

#### 2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

#### 2.1.4 NOT USED

#### 2.1.5 Nonfrost Susceptible (NFS) Material

Nonfrost susceptible material shall be a uniformly graded washed sand with a maximum particle size of 1/2 inch and less than 5 percent passing the No. 200 size sieve, and with not more than 3 percent by weight finer than 0.02 mm grain size.

### 2.2 CAPILLARY WATER BARRIER

Capillary Water Barrier shall consist of clean, crushed, nonporous rock, crushed gravel, or uncrushed gravel. The maximum particle size shall be 1-1/2 inches and no more than 2 percent by weight shall pass the No. 4 size sieve.

## PART 3 EXECUTION

### 3.1 CLEARING AND GRUBBING

Clearing and grubbing is specified in Section C-02110 CLEARING AND GRUBBING.

### 3.2 TOPSOIL

Topsoil shall be stripped to full depth or to a depth of 6 inches, whichever is greater, below existing grade within the designated excavations and grading lines and deposited in storage piles for later use. Excess topsoil shall be disposed as specified for excess excavated material.

### 3.3 EXCAVATION

Excavation shall conform to the dimensions and elevations indicated for each building, structure, and footing except as specified hereinafter, and shall include trenching for utility systems to a point 5 feet beyond the building line of each building and structure, and all work incidental thereto. Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered

below the grades shown shall be removed as directed and replaced with satisfactory material. Payment therefore will be made in conformance with the CHANGES clause of the CONTRACT CLAUSES. Satisfactory material removed below the depths indicated without specific direction of the Contracting Officer shall be replaced at no additional cost to the Government to the indicated excavation grade with satisfactory materials, except that concrete footings shall be increased in thickness to the bottom of the overdepth excavations. Satisfactory material shall be placed and compacted as specified in paragraph FILLING AND BACKFILLING. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

### 3.4 DRAINAGE AND DEWATERING

#### 3.4.1 Drainage

Surface water shall be directed away from excavation and construction sites so as to prevent erosion and undermining of foundations. Diversion ditches, dikes and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site and the area immediately surrounding the site and affecting operations at the site shall be continually and effectively drained.

#### 3.4.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously below the working level.

### 3.5 SHORING

Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving.

### 3.6 CLASSIFICATION OF EXCAVATION

Excavation will be unclassified regardless of the nature of material encountered.

### 3.7 BLASTING

Blasting will not be permitted.

### 3.8 UTILITY AND DRAIN TRENCHES

Trenches for underground utilities systems and drain lines shall be excavated to the required alignments and depths. The bottoms of trenches shall be graded to secure the required slope and shall be tamped if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length.

### 3.9 BORROW



Where satisfactory materials are not available in sufficient quantity from required excavations, approved materials shall be obtained as specified in Section C-02225 EARTHWORK FOR ROADWAYS, PAVEMENTS, AND GRAVELLED AREAS.

### 3.10 EXCAVATED MATERIALS

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required under this section or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Section 02225 EARTHWORK FOR ROADWAYS, PAVEMENT AND AIRFIELDS.

### 3.11 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Excavation to final grade shall not be made until just before concrete is to be placed.

### 3.12 SUBGRADE PREPARATION

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that is within 3% of the optimal moisture content as prescribed by ASTM D1557. Minimum subgrade density shall be as specified in paragraph FILLING AND BACKFILLING.

### 3.13 FILLING AND BACKFILLING

Satisfactory materials shall be used in bringing fills and backfills to the lines and grades indicated and for replacing unsatisfactory materials. Satisfactory materials shall be placed in horizontal layers not exceeding 8 inches in loose thickness, or 6 inches when hand-operated compactors are used. After placing, each layer shall be plowed, disked, or otherwise broken up, moistened or aerated as necessary, thoroughly mixed and compacted as specified. Material shall be moistened or aerated to provide the moisture content that is within 3% of the optimal moisture content as prescribed by ASTM D1557. Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade. Backfill shall not be placed in wet or frozen areas. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 2 feet above sewer lines and 1 foot above other utility lines shall be free from stones larger than 1 inch in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes to avoid damage to coatings or wrappings. Backfill shall not be placed against foundation walls prior to 7 days after completion of the

walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall. Each layer of fill and backfill shall be compacted to not less than the percentage of maximum density specified below:

	Percent Laboratory maximum density	
	Cohesive material	Cohesionless material
Fill, embankment, and backfill		
Under structures, building slabs, steps, paved areas, around footings, and in trenches	90	95
Under sidewalks and grassed areas	85	90
Nonfrost susceptible materials		95
Subgrade		
Under building slabs, steps, and paved areas, top 12 inches	90	95
Under sidewalks, top 6 inches	85	90

Approved compacted subgrades that are disturbed by the Contractor's operations or adverse weather shall be scarified and compacted as specified herein before to the required density prior to further construction thereon. Recompression over underground utilities and heating lines shall be by hand tamping.

### 3.15 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or may be performed by the Contractor subject to approval. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted if necessary by the procedure described in ASTM D 2922, paragraph ADJUSTING CALIBRATION CURVE. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. ASTM D 2937 shall be used only for soft, fine-grained, cohesive soils. The following number of tests, if performed at the appropriate time, shall be the minimum acceptable for each type operation.

#### 3.15.1 In-Place Densities

##### 3.15.1.1 In-Place Density of Subgrades

One test per 5000 square foot or fraction thereof.

##### 3.15.1.2 In-Place Density of Fills and Backfills

One test per 5000 square foot or fraction thereof of each lift for fill or backfill areas compacted by other than hand or hand-operated machines. The density for each lift of fill or backfill materials for trenches, pits, building perimeters or other structures or areas less than 3 feet in width, which are compacted with hand or hand-operated machines shall be tested as follows: One test per each area less than 1000 square feet, or one test for each 300 linear foot of long narrow fills 300 feet or more in length. If ASTM D 2922 is used, in-place densities shall be checked by ASTM D 1556 as follows: One check per lift for each 300 linear feet of long narrow fills, and a minimum of 2 checks per lift for other fill and backfill areas.

### 3.15.2 Moisture Content

In the stockpile, excavation or borrow areas, a minimum of two tests per day per type of material or source of materials being placed is required during stable weather conditions. During unstable weather, tests shall be made as dictated by local conditions and approved moisture content shall be tested in accordance with ASTM D 2216.

### 3.15.3 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 500 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density will be made.

### 3.16 CAPILLARY WATER BARRIER

Capillary water barrier under concrete floor and area-way slabs on grade shall be placed directly on the subgrade and shall be compacted with a minimum of two passes of a hand-operated plate-type vibratory compactor.

### 3.17 GRADING

Areas within 5 feet outside of each building and structure line shall be constructed true-to-grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

### 3.18 NOT USED

### 3.19 PROTECTION

Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work shall be repaired and grades reestablished to the required elevations and slopes.

-- End of Section --

## SECTION C-02225

### EARTHWORK FOR ROADWAYS, RAILROADS, AND AIRFIELDS

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 136	(1995a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1140	(1992) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbs/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2937	(1994) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1993) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

##### 1.2 NOT USED

##### 1.3 NOT USED

##### 1.4 DEFINITIONS

###### 1.4.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GC, GM, SW, SP, SM, SC, and CL. Satisfactory materials for grading shall be free from roots and other organic matter, trash, debris, and frozen materials and stones larger than 6 inches in any dimension.

#### 1.4.2 Unsatisfactory Materials

Unsatisfactory materials shall comprise any materials classified by ASTM D 2487 as Pt, OH, OL, MH, ML, and CH. Unsatisfactory materials also include man-made fills, refuse, or backfills from previous construction.

#### 1.4.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, and CL. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Testing required for classifying materials shall be in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

#### 1.4.4 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557. This will be abbreviated below as a percent of laboratory maximum density.

#### 1.4.5 NOT USED

#### 1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-08 Statements

Testing Lab Qualifications; FIO.

Qualifications of the commercial testing laboratory or Contractor's testing facilities who will be performing all testing in accordance with Paragraph TESTING.

##### SD-09 Reports

Field Testing Control; FIO.

Within 24 hours of conclusion of physical tests, copies of test results, including calibration curves and results of calibration tests.

#### 1.6 SUBSURFACE DATA

Subsurface soil boring logs are shown on the drawings in the F Series. The subsoil investigation report and samples of materials taken from subsurface investigations may be examined at Office of the District Engineer, U.S. Army Engineering, District, Louisville, Corps of Engineers, Federal Office Building, Louisville, Kentucky. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

#### 1.7 CLASSIFICATION OF EXCAVATION

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

##### 1.7.1 NOT USED

##### 1.7.2 NOT USED

## 1.8 BLASTING

Blasting will not be permitted.

## 1.9 UTILIZATION OF EXCAVATED MATERIALS

Unsatisfactory materials removed from excavations shall be disposed of in designated waste disposal or spoil areas. Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. No satisfactory excavated material shall be wasted without specific written authorization. Satisfactory material authorized to be wasted shall be disposed of in designated areas approved for surplus material storage or designated waste areas as directed. Newly designated waste areas on Government-controlled land shall be cleared and grubbed before disposal of waste material thereon. Coarse rock from excavations shall be stockpiled and used for constructing sides and bottoms of channels and for protecting against erosion. No excavated material shall be disposed of in such a manner as to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

## PART 2 PRODUCTS (Not Applicable)

## PART 3 EXECUTION

### 3.1 STRIPPING OF TOPSOIL

Under proposed pavements, gravelled areas, buildings or embankments, topsoil shall be stripped to full depth or a depth of 6 inches, whichever is greater. Topsoil shall be spread on areas already graded and prepared for topsoil, or when so specified topsoil shall be transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated. Topsoil shall be kept separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations.

### 3.2 EXCAVATION

The Contractor shall perform excavation of every type of material encountered within the limits of the project, to the lines, grades, and elevations indicated and as specified herein. Grading shall be in conformity with the typical sections shown and the tolerances specified in paragraph FINISHING. Satisfactory excavated materials shall be transported to and placed in fill or embankment within the limits of the work. Unsatisfactory materials encountered within the limits of the work shall be excavated below grade and replaced with satisfactory materials. Such excavated material and the satisfactory material ordered as replacement shall be included in excavation. Surplus satisfactory excavated material not required for fill or embankment shall be disposed of in areas approved for surplus material storage or designated waste areas. Unsatisfactory excavated material shall be disposed of in designated waste or spoil areas. During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times. Material required for fill or embankment in excess of that produced by excavation within the grading limits shall be excavated from the borrow areas indicated.

#### 3.2.1 NOT USED

#### 3.2.2 Drainage Structures

Excavations shall be made accurately to the lines, grades, and elevations shown or as directed. Trenches and foundation pits shall be of sufficient size to

permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock or other hard foundation material shall be cleaned of loose debris and cut to a firm, level, stepped, or serrated surface. Loose disintegrated rock and thin strata shall be removed. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

### 3.3 SELECTION OF BORROW MATERIAL

Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas shown. Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

### 3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

Except as otherwise permitted, borrow pits and other excavation areas shall be excavated in such manner as will afford adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of as directed. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

### 3.5 NOT USED

### 3.6 BACKFILL

Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials, in such a manner as to prevent wedging action or eccentric loading upon or against any structure. Ground surface on which backfill is to be placed shall be prepared as specified in paragraph PREPARATION OF GROUND SURFACE FOR EMBANKMENTS. Compaction requirements for backfill materials shall also conform to the applicable portions of paragraphs PREPARATION OF GROUND SURFACE FOR EMBANKMENTS, EMBANKMENTS, and SUBGRADE PREPARATION, below and Section C-02720 STORM-DRAINAGE SYSTEM; and Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

### 3.7 PREPARATION OF GROUND SURFACE FOR EMBANKMENTS

Ground surface on which fill is to be placed shall be stripped of live, dead, or decayed vegetation, rubbish, debris, and other unsatisfactory material; plowed, disked, or otherwise broken up to a depth of 6 inches; pulverized; moistened or aerated as necessary to plus or minus three percent of optimum moisture; thoroughly mixed; and compacted a minimum of 12 inches below the surface to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment well suited to the material being compacted. The prepared ground surface shall be scarified and moistened or aerated as required just prior to placement of embankment materials to assure adequate bond between embankment material and the prepared ground surface.

### 3.8 EMBANKMENTS

#### 3.8.1 Earth Embankments

Earth embankments shall be constructed from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches. The material shall be placed in successive horizontal layers of loose material not more than 8 inches in depth. Each layer shall be spread uniformly on a soil surface that has been moistened or aerated as necessary to plus or minus three percent of optimum moisture and scarified or otherwise broken up in such a manner that the fill will bond with the surface on which it is placed. After spreading, each layer shall be plowed, disked, or otherwise broken up; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements shall be identical with those requirements specified in paragraph SUBGRADE PREPARATION. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

#### 3.8.2 NOT USED

### 3.9 SUBGRADE PREPARATION

#### 3.9.1 Construction

Subgrade shall be shaped to line, grade, and cross section, and compacted as specified. This operation shall include plowing, disking, and any moistening or aerating required to obtain specified compaction. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed. Rock encountered in the cut section shall be excavated to a depth of 6 inches below finished grade for the subgrade. Low areas resulting from removal of unsatisfactory material or excavation of rock shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade, and cross section and compacted as specified. After rolling, the surface of the subgrade for roadways shall not show deviation greater than 1/2 inch when tested with a 10-foot straightedge applied both parallel and at right angles to the centerline of the area. The elevation of the finished subgrade shall not vary more than 0.05 foot from the established grade and cross section.

#### 3.9.2 Compaction

Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas and railroads, each layer of embankment shall be compacted to at least 85 percent of laboratory maximum density for cohesive soils and 90 percent of laboratory maximum density for cohesionless soils.

##### 3.9.2.1 NOT USED

##### 3.9.2.2 Subgrade for Pavements, Gravelled Areas and Shoulders

Subgrade for pavements shall be compacted to at least 90 percent of laboratory maximum density for cohesive soils and 95 percent of laboratory maximum density for cohesionless soils for a minimum of 12 inches below the surface of the subgrade.

##### 3.9.2.3 NOT USED

#### 3.10 NOT USED



### 3.11 FINISHING

The surface of all excavations, embankments, and subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for all graded areas shall be within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades shall be specified in paragraph SUBGRADE PREPARATION above. Gutters and ditches shall be finished in a manner that will result in effective drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turfing materials.

### 3.12 PLACING TOPSOIL

On areas to receive topsoil, the compacted subgrade soil shall be scarified to a 2 inch depth for bonding of topsoil with subsoil. Topsoil then shall be spread evenly to a thickness of 6 inches and graded to the elevations and slopes shown. Topsoil shall not be spread when frozen or excessively wet or dry. Material required for topsoil in excess of that produced by excavation within the grading limits shall be obtained from areas indicated.

### 3.13 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or may be tested by the Contractor subject to approval. If the Contractor elects to establish testing facilities, no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved by the Contracting Officer. The first inspection shall be at the expense of the Government. Cost incurred for any subsequent inspections required because of failure of the first inspection will be charged to the Contractor. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017, the calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and in intervals as directed by the Contracting Officer. ASTM D 2937, the Drive Cylinder Method shall be used only for soft, fine-grained, cohesive soils. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, the material shall be removed, replaced and recompact to meet specification requirements, at no additional expense to the Government. Tests on recompact areas shall be performed to determine conformance with specification requirements. Inspections and test results shall be certified by a licensed professional civil engineer. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

#### 3.13.1 NOT USED

#### 3.13.2 In-Place Densities

a. One test per 3000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

b. One test per 400 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

### 3.13.3 Check Tests on In-Place Densities

If ASTM D 2922 is used, in-place densities shall be checked by ASTM D 1556 as follows:

a. One check test per lift for each 30,000 square feet, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.

b. One check test per lift for each 4,000 square feet, of fill or backfill areas compacted by hand-operated machines.

### 3.13.4 Moisture Contents

In the stockpile, excavation or borrow areas, a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, tests shall be made as dictated by local conditions and approved by the Contracting Officer.

### 3.13.5 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 3,000 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

### 3.13.6 Tolerance Tests for Subgrades

Continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION shall be made during construction of the subgrades.

## 3.14 SUBGRADE AND EMBANKMENT PROTECTION

During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained in such a manner as to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition until subbase, base, or pavement is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted. No subbase, base course, or pavement shall be laid until the subgrade has been checked and approved, and in no case shall subbase, base, surfacing, or pavement be placed on a muddy, spongy, or frozen subgrade.

-- End of Section --

## SECTION C-02230

### CLEARING AND GRUBBING

#### PART 1 GENERAL

##### 1.1 DEFINITIONS

###### 1.1.1 Clearing

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in the areas to be cleared.

###### 1.1.2 Grubbing

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas.

##### 1.2 NOT USED

##### 1.3 NOT USED

##### 1.4 NOT USED

#### PART 2 PRODUCTS (Not Applicable)

#### PART 3 EXECUTION

##### 3.1 CLEARING

Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface. Clearing shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work.

##### 3.2 GRUBBING

Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

##### 3.3 TREE REMOVAL

Where indicated, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

##### 3.4 DISPOSAL OF MATERIALS

###### 3.4.1 Salable Timber

All felled timber from which saw logs, pulpwood, posts, poles, ties, mine props, or cordwood can be produced shall be considered as salable timber, and may be salvaged by the Contractor.

#### 3.4.2 Disposal of Waste Materials

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations shall be disposed of as specified in Section C-02050.

-- End of Section --

SECTION C-02233

GRADED-CRUSHED-AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION  
OFFICIALS(AASHTO)

AASHTO T 180 (1993) Moisture-Density Relations of Soils Using  
a 10-lb. (4.54 kg) Rammer and an 18-in (457 mm)  
Drop

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29 (1991a) Unit Weight and Voids in  
Aggregate

ASTM C 88 (1990) Soundness of Aggregates by Use of  
Sodium Sulfate or Magnesium Sulfate

ASTM C 117 (1995) Materials Finer Than  
75-micrometer (No. 200) Sieve in Mineral  
Aggregates by Washing

ASTM C 131 (1989) Resistance to Degradation of  
Small-Size Coarse Aggregate by Abrasion and  
Impact in the Los Angeles Machine

ASTM C 136 (1995a) Sieve Analysis of Fine and  
Coarse Aggregates

ASTM D 75 (1987; R 1992) Sampling Aggregates

ASTM D 1556 (1990) Density and Unit Weight of Soil in  
Place by the Sand-Cone Method

ASTM D 1557 (1991) Laboratory Compaction  
Characteristics of Soil Using Modified Effort  
(56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))

ASTM D 2487 (1993) Classification of Soils for  
Engineering Purposes (Unified Soil  
Classification System)

ASTM D 2922 (1991) Density of Soil and Soil-Aggregate  
in Place by Nuclear Methods (Shallow Depth)

ASTM D 3017 (1988; 1993) Water Content of Soil and Rock  
in Place by Nuclear Methods (Shallow Depth)

ASTM D 4318 (1993) Liquid Limit, Plastic Limit, and  
Plasticity Index of Soils

ASTM E 11 (1995) Wire-Cloth Sieves for Testing  
Purposes

KENTUCKY TRANSPORTATION CABINET DEPARTMENT OF HIGHWAYS, FRANKFORT,  
KENTUCKY (KDOH)

KDOH Standard Specifications for Road and Bridge  
Construction - 1998

1.2 NOT USED

1.3 NOT USED

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01300 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Equipment; FIO.

List of proposed equipment to be used in performance of construction work, including descriptive data.

SD-08 Statements

Testing Lab Qualifications; FIO.

Qualifications of the commercial testing laboratory or Contractor's testing facilities who will be performing all testing in accordance with Paragraph SAMPLING AND TESTING.

SD-09 Reports

Sampling and testing; FIO.

Copies of field test results.

1.5 NOT USED

1.6 EQUIPMENT

1.6.1 Approval

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

1.6.2 Weather Limitation

Base courses shall be placed when the atmospheric temperature is above 35 degrees F. Areas of completed base course that are damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirement.

1.7 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved commercial testing laboratory, or by

the Contractor subject to approval. If the Contractor elects to establish testing facilities of his own, approval of such facilities shall be based on compliance with ASTM E 548, and no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved. The first inspection of the facilities shall be at the expense of the Government and any subsequent inspections required because of failure of the first inspection will be at the expense of the Contractor. Such costs will be deducted from the total amount due the Contractor. The materials shall be tested to establish compliance with the specified requirements. Copies of test results shall be furnished to the Contracting Officer.

#### 1.7.1 Sampling

Sampling for material gradation tests shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

#### 1.7.2 Tests

The following tests shall be performed in conformance with the applicable standards listed at a frequency of one set of tests for every 1000 square yards of completed area.

##### 1.7.2.1 Sieve Analyses

Sieve analyses shall be made in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11.

##### 1.7.2.2 NOT USED

##### 1.7.2.3 NOT USED

##### 1.7.2.4 Soundness Test

Soundness tests shall be made in conformance with ASTM C 88.

##### 1.7.2.5 Wear Test

Wear tests shall be made in conformance with ASTM C 131.

#### 1.7.3 Approval of Material

The source of the material to be used for producing aggregates shall be selected 30 days prior to the time the material will be required in the work. Tentative approval of the source will be based on an inspection by the Contracting Officer. Tentative approval of material will be based on tests of samples for the specific job. Final approval of both the source and the material will be based on tests for gradation, performed on samples taken from the completed and compacted base course.

## PART 2 PRODUCTS

### 2.1 AGGREGATES

Aggregates shall consist of clean, sound, durable particles of crushed stone, crushed slag, or crushed gravel, and screenings. The Contractor shall obtain materials that meet the specification and can be used to meet the grade and smoothness requirements specified herein, after all compaction operations have been completed. Slag shall be an air-cooled, blast-furnace product having a dry weight of not less than 65 pcf as determined by ASTM C 29. The aggregates shall be free of silt and clay as defined by ASTM D 2487, vegetable matter, and other objectionable materials or coatings. The portion retained on the No. 4 sieve

shall be known as coarse aggregate; that portion passing the No. 4 sieve shall be known as fine aggregate.

#### 2.1.1.1 Coarse Aggregates

Coarse aggregates shall be angular particles of uniform density. The coarse aggregate shall have a loss not greater than 18 percent weighted averaged at five cycles when tested for soundness in magnesium sulfate in accordance with ASTM C 88. The coarse aggregate shall have a percentage of wear not to exceed 40 after 500 revolutions as determined by ASTM C 131. The percentage of flat and/or elongated particles shall not exceed 20 in the fraction retained on the 1/2 inch sieve and in the fraction passing the 1/2 inch sieve. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the requirements set forth herein. Crushed gravel shall be manufactured from gravel particles 90 percent of which by weight are retained on the maximum-size sieve listed in TABLE I. In the portion retained on each sieve specified, the crushed gravel shall contain at least 90 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the piece. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces.

#### 2.1.1.2 Fine Aggregate

Fine aggregate shall be angular particles produced by crushing stone, slag, or gravel that meets the requirements for wear and soundness specified for coarse aggregate. Fine aggregate shall be produced by crushing only particles larger than No. 4 sieve in size. The fine aggregate shall contain at least 90 percent by weight of particles having two or more freshly fractured faces in the portion passing the No. 4 sieve and retained on the No. 10 sieve, and in the portion passing the No. 10 sieve and retained on the No. 40 sieve.

#### 2.1.1.3 Gradation Requirements

Gradation requirements specified herein shall apply to the completed base course. The aggregates shall have a maximum size as shown and be graded continuously well within the limits specified in TABLE I. Sieves shall conform to ASTM E 11.

TABLE I. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	Base Course KY No. 57	Choker Course KY No. 11
1 1/2 inch	100	-----
1	95-100	-----
3/4	-----	-----
1/2	25-60	-----
3/8	-----	100
No. 4	0-10	40-90
No. 8	0-5	10-40
No. 10	-----	-----
No. 16	-----	-----
No. 40	-----	-----
No. 100	-----	0-5
No. 200	-----	-----



NOTE 1: Particles having diameters less than 0.02 mm shall not be in excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity, and the percentages passing the various sieves may require appropriate correction by the Contracting Officer when aggregates of varying specific gravities are used.

#### 2.1.4 NOT USED

### PART 3 EXECUTION

#### 3.1 OPERATION OF AGGREGATE SOURCES

Clearing, stripping, and excavating shall be the responsibility of the Contractor. The aggregate sources shall be operated in such a manner as to produce the quantity and quality of base course materials meeting these specification requirements in the specified time limits. Upon completion of the work, the aggregate sources on Government reservations shall be conditioned to drain readily and be left in a satisfactory condition. Aggregate sources on private lands shall be conditioned in agreement with local laws or authorities.

#### 3.2 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer so as to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

#### 3.3 PREPARATION OF UNDERLYING COURSE

Prior to constructing the crushed-aggregate base course, the underlying course shall be cleaned of all foreign substances. At the time of construction of the base course, the underlying course shall contain no frozen material. The underlying course shall conform to Section C-02225 EARTHWORK FOR ROADWAYS, RAILROADS, AND AIRFIELDS and Section C-02234 SUBBASE COURSE. Ruts or soft, yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompact to specified density requirements. For cohesionless underlying courses containing sands or gravels as defined in ASTM D 2487 the surface shall be stabilized prior to placement of the graded-crushed-aggregate base course. Stabilization shall be accomplished by mixing graded-crushed-aggregate base material into the underlying course and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the base course is placed.

#### 3.4 GRADE CONTROL

During construction, the lines and grades including crown and cross slope indicated for the base course shall be maintained by means of line and grade stakes placed by the Contractor.

#### 3.5 NOT USED

#### 3.6 PLACING

The mixed material shall be placed on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 6 inches or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 6 inches is required, the material shall be placed in layers of equal thickness. No layer shall exceed 6 inches or be less than 3 inches when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the base course is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable base course.

### 3.7 COMPACTION

#### 3.7.1 Requirements

The drainage layer (KY No. 57) shall be compacted with 6 passes of a 10 ton vibratory roller as directed by the Contracting Officer. Overrolling to the extent that the aggregate particles are being broken shall be avoided. In all places not accessible to the rollers, the base course material shall be compacted with mechanical tampers to the satisfaction of the Contracting Officer.

#### 3.7.2 Finishing

The surface of top layer of base course shall be finished after final compaction, and proof rolled, where required, by cutting any overbuild to grade and rolling with a steel-wheeled roller. In no case will thin layers of material be added to the top layer of base course to meet grade. If the elevation of top layer of base course is 1/2 inch or more below the grade, the top layer of base shall be scarified to a depth of at least 3 inches, new material shall be added, and the layer shall be blended and recompacted to bring to grade. Adjustments in rolling and finishing procedures shall be made as may be directed to obtain grades, to minimize segregation and degradation of base course material, to adjust the water content, and to insure an acceptable base course. Material found unacceptable shall be removed and replaced, as directed, with acceptable material.

#### 3.7.3 Choker Course

A choker course will be placed on top of the No. 57 base course and compacted into the base course to provide a rideable surface for paving machines. The choker course shall be placed by tailgate methods and graded to a maximum of 1-inch depth and compacted into the base course layer by two passes of a 10-ton vibratory roller. The thickness of the base course shall not be increased by the addition of the choker course.

### 3.8 NOT USED

### 3.9 EDGES OF BASE COURSE

Acceptable material shall be placed along the edges of the base course in such quantity as will compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, at least a 1-foot width of the shoulder shall be rolled and compacted simultaneously with the rolling and compacting of each layer of the base course, as directed.

### 3.10 SMOOTHNESS TEST

The surface of the top layer shall not deviate more than 3/8 inch when tested with a 10-foot straightedge applied parallel with and at right angles to the

centerline of the area to be paved. Deviations exceeding 3/8 inch shall be corrected as directed.

### 3.11 THICKNESS CONTROL

The completed thickness of the base course shall be within 1/2 inch of the thickness indicated. The thickness of the base course shall be measured at intervals providing at least one measurement for each 500 square yards of base course. The depth measurement shall be made by test holes at least 3 inches in diameter. Where the measured thickness of the base course is more than 1/2 inch deficient, such areas shall be corrected by excavating to the required depth and replacing with new material. Where the measured thickness of the base course is 1/2 inch more than indicated, it will be considered as conforming with the requirements plus 1/2 inch, provided the surface of the base course is within 1/2 inch of established grade. The average job thickness shall be the average of the job measurements as specified above but within 1/4 inch of the thickness indicated.

### 3.12 MAINTENANCE

The base course shall be maintained in a condition that will meet all specification requirements until accepted.

-- End of Section --

SECTION C-02234

SUBBASE COURSE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION  
OFFICIALS(AASHTO)

AASHTO T 180 (1993) Moisture-Density Relations of Soils Using  
a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29 (1991a) Unit Weight and Voids in  
Aggregate

ASTM C 117 (1995) Materials Finer Than  
75-micrometer (No. 200) Sieve in Mineral  
Aggregates by Washing

ASTM C 131 (1996) Resistance to Degradation of  
Small-Size Coarse Aggregate by Abrasion and  
Impact in the Los Angeles Machine

ASTM C 136 (1995a) Sieve Analysis of Fine and  
Coarse Aggregates

ASTM D 75 (1987; R 1992) Sampling Aggregates

ASTM D 422 (1963; R 1990) Particle-Size Analysis of Soils

ASTM D 1556 (1990) Density and Unit Weight of Soil in  
Place by the Sand-Cone Method

ASTM D 1557 (1991) Laboratory Compaction  
Characteristics of Soil Using Modified Effort  
(56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))

ASTM D 2167 (1994) Density and Unit Weight of  
Soil in Place by the Rubber Balloon Method

ASTM D 2487 (1993) Classification of Soils for  
Engineering Purposes (Unified Soil  
Classification System)

ASTM D 2922 (1991) Density of Soil and Soil-Aggregate  
in Place by Nuclear Methods (Shallow Depth)

ASTM D 3017 (1988; R 1993) Water Content of Soil and Rock  
in Place by Nuclear Methods (Shallow Depth)

ASTM D 4318 (1993) Liquid Limit, Plastic Limit, and  
Plasticity Index of Soils

ASTM E 11 (1995) Wire-Cloth Sieves for Testing

## Purposes

### KENTUCKY DEPARTMENT OF HIGHWAYS (KDOH)

KDOH

Standard Specifications for Road and Bridge  
Construction - 1998

#### 1.2 NOT USED

#### 1.3 DEGREE OF COMPACTION

Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557. In this specification, degree of compaction shall be a percentage of laboratory maximum density.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-01 Data

Equipment; FIO.

List of proposed equipment to be used in performance of construction work, including descriptive data.

##### SD-08 Statements

Testing Lab Qualifications; FIO.

Qualifications of the commercial testing laboratory or Contractor's testing facilities who will be performing all testing in accordance with Paragraph SAMPLING AND TESTING.

##### SD-09 Reports

Sampling and Testing; FIO.

Copies of Test Results.

#### 1.5 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved testing laboratory in accordance with Section C-01440 CONTRACTOR QUALITY CONTROL. Tests shall be performed at the specified frequency. No work requiring testing will be permitted until the testing laboratory has been inspected and approved. The materials shall be tested to establish compliance with the specified requirements.

##### 1.5.1 Sampling

Sampling for laboratory testing shall be in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

##### 1.5.2 Tests

The following tests shall be performed in conformance with the applicable standards listed at a frequency of one set of tests for every 1000 square yards of completed area.

#### 1.5.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11.

#### 1.5.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

#### 1.5.2.3 Moisture-Density Determinations

The maximum density and optimum moisture shall be determined in accordance with ASTM D 1557 or AASHTO T 180, Method D.

#### 1.5.2.4 Density Tests

Density shall be measured in the field in accordance with ASTM D 1556, ASTM D 2167 or ASTM D 2922. For the method presented in ASTM D 1556 the base plate as shown in the drawing shall be used. For the method presented in ASTM D 2922 the calibration curves shall be checked, and adjusted if necessary, using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D 2922 result in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration, in ASTM D 2922, on each different type of material to be tested at the beginning of a job and at intervals as directed.

#### 1.5.2.5 Wear Test

Wear tests shall be made in conformance with ASTM C 131.

#### 1.5.2.6 Weight of Slag

Weight per cubic foot of slag shall be determined in accordance with ASTM C 29 on the subbase course material.

### 1.5.3 Testing Frequency

#### 1.5.3.1 Initial Tests

One of each of the following tests shall be performed on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements prior to installation.

- a. Sieve Analysis including 0.02 mm size material
- b. Liquid limit and plasticity index moisture-density relationship
- c. Wear
- d. Weight per cubic foot of Slag

#### 1.5.3.2 In-Place Tests

One of each of the following tests shall be performed on samples taken from the placed and compacted subbase and select-material subbase course. Samples shall be taken for each 1000 square yards of each layer of material placed in each area.

- a. Sieve Analysis including 0.02 mm size material
- b. Field Density
- c. Moisture liquid limit and plasticity index

#### 1.5.4 Approval of Material

The source of the material shall be selected 30 days prior to the time the material will be required in the work. Approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and compacted subbase course.

#### 1.6 WEATHER LIMITATIONS

Construction shall be done when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, the Contractor shall protect all completed areas by approved methods against detrimental effects of freezing. Completed areas damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements.

#### 1.7 EQUIPMENT

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

##### 2.1.1 Subbase Course

Aggregates shall consist of crushed stone or slag, gravel, shell, sand, or other sound, durable, approved materials processed and blended or naturally combined. Aggregates shall be durable and sound, free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign material. Material retained on the No. 4 sieve shall have a percentage of wear not to exceed 50 percent after 500 revolutions when tested as specified in ASTM C 131. Aggregate shall be reasonably uniform in density and quality. Slag shall be an air-cooled, blast-furnace product having a dry weight of not less than 65 pcf. Aggregates shall have a maximum size of 1 inch and shall be within the limits specified as follows:

#### Subbase Course, KY DGA

Sieve Designation by Weight	Maximum Allowable Percentage Passing Square-Mesh Sieve
1-inch	100
3/4-inch	70-100
3/8-inch	50-80
No. 4	30-65
No. 10	17-50
No. 40	8-30
No. 200	2-10

The portion of any blended component and of the completed course passing the No. 40 sieve shall be either nonplastic or shall have a liquid limit not greater than 25 and a plasticity index not greater than 5.

#### 2.1.2 Select-Material Subbase Course

Materials shall consist of selected soil or other materials from field excavation, stockpiles, or other sources. Material shall be free from lumps and balls of clay and from organic and other objectionable matter. Not more than 25 percent by weight shall pass the No. 200 sieve. The portion of material passing the No. 40 sieve shall have a liquid limit less than 35 and a plasticity index less than 12. The maximum particle size shall not exceed 3 inches. Particles having diameters less than 0.02 millimeter shall not be in excess of 3 percent by weight of the total sample tested as determined in accordance with ASTM D 422.

### PART 3 EXECUTION

#### 3.1 OPERATION OF AGGREGATE SOURCES

All clearing, stripping and excavating work involved in the opening or operation of aggregate sources shall be performed by the Contractor. Aggregate sources shall be opened to working depth in a manner that produces excavation faces that are as nearly vertical as practicable for the materials being excavated. Materials excavated from aggregate sources shall be obtained in successive cuts extending through all exposed strata. All pockets or strata of unsuitable materials overlying or occurring in the deposit shall be wasted as directed. The methods of operating aggregate sources and the processing and blending of the material may be changed or modified by the Contracting Officer when necessary in order to obtain material conforming to specified requirements. Upon completion of work, aggregate sources on Government reservations shall be conditioned to drain readily, and shall be left in a satisfactory condition. Aggregate sources on private lands shall be conditioned in agreement with local laws and authorities.

#### 3.2 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer so as to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

#### 3.3 PREPARATION OF UNDERLYING MATERIAL

Prior to constructing the subbase course, the underlying course shall be cleaned of all foreign substances. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. Ruts or soft, yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses containing sands or gravels, as defined in ASTM D 2487, the surface shall be stabilized prior to placement of the subbase course. Stabilization shall be accomplished by mixing subbase-course material into the underlying course, and compacting by approved methods. The stabilized material will be considered as part of the underlying course and shall meet all requirements for the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the subbase course is placed.

#### 3.4 GRADE CONTROL



The finished and completed subbase course shall conform to the lines, grades, and cross sections shown. The lines, grades, and cross sections shown shall be maintained by means of line and grade stakes placed by the Contractor at the site of the work.

### 3.5 MIXING AND PLACING MATERIALS

The materials shall be mixed and placed to obtain uniformity of the subbase and select material subbase material at the water content specified. The Contractor shall make such adjustments in mixing or placing procedures or in equipment as may be directed to obtain the true grades, to minimize segregation and degradation, to reduce or accelerate loss or increase of water, and to insure a satisfactory subbase course.

### 3.6 LAYER THICKNESS

The compacted thickness of the subbase course shall be as indicated. When a compacted layer of 6 inches is specified, the material may be placed in a single layer; when a compacted thickness of more than 6 inches is required, no layer shall exceed 6 inches nor be less than 3 inches when compacted.

### 3.7 COMPACTION

Each layer of the subbase course shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure such that the water content is within plus or minus 2 percent of optimum water content as determined from laboratory tests as specified in paragraph SAMPLING AND TESTING. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer is compacted through the full depth to at least 95 percent of laboratory maximum density. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to insure a satisfactory subbase course. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

### 3.8 NOT USED

### 3.9 EDGES

Approved material shall be placed along the edges of the subbase and select material subbase course in such quantity as will compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, at least a 1-foot width of the shoulder shall be rolled and compacted simultaneously with the rolling and compacting of each layer of the subbase course, as directed.

### 3.10 SMOOTHNESS TEST

The surface of each layer shall not show deviations in excess of 3/8 inch when tested with a 10-foot straightedge applied parallel with and at right angles to the centerline of the area to be paved. Deviations exceeding this amount shall be corrected by removing material, replacing with new material, or reworking existing material and compacting, as directed.

### 3.11 THICKNESS CONTROL

The completed thickness of the subbase and select material subbase course shall be in accordance with the thickness and grade indicated on the drawings. The thickness of the subbase course shall be measured at intervals providing at least one measurement for each 500 square yards of subbase course. The thickness measurement shall be made by test holes, at least 3 inches in diameter through the course. The completed subbase course shall not be more than 1/2 inch deficient in thickness nor more than 1/2 inch above or below the established grade. Where any of these tolerances are exceeded, the Contractor shall correct such areas by scarifying, adding new material of proper gradation or removing material, and compacting, as directed. Where the measured thickness of the subbase course is 1/2 inch or more thicker than shown, the course will be considered as conforming with the specified thickness requirements plus 1/2 inch. The average job thickness shall be the average of the job measurements as specified above but within 1/4 inch of the thickness shown.

### 3.12 MAINTENANCE

The subbase course shall be maintained in a satisfactory condition until accepted.

-- End of Section --

## SECTION C-02316

### EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

##### 1.2 NOT USED

##### 1.3 DEGREE OF COMPACTION

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

##### 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-08 Statements

Testing Lab Qualifications; FIO.

Qualifications of the commercial testing laboratory or Contractor's testing facilities who will be performing all testing in accordance with Paragraph TESTING.

## SD-09 Reports

Field Density Tests; FIO. Testing of Backfill Materials; FIO.

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

##### 2.1.1 Satisfactory Materials

Satisfactory materials shall consist of any material classified by ASTM D 2487 as GW, GP, GM, GC, SW, SP, SM, SC, ML, and CL.

##### 2.1.2 Unsatisfactory Materials

Unsatisfactory materials shall be materials that do not comply with the requirements for satisfactory materials. Unsatisfactory materials include but are not limited to those materials containing roots and other organic matter, trash, debris, frozen materials and stones larger than 3 inches, and materials classified in ASTM D 2487, as PT, OH, OL, MH and CH. Unsatisfactory materials also include man-made fills, refuse, or backfills from previous construction.

##### 2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, and CL. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

##### 2.1.4 Rock

Rock shall consist of boulders measuring 1/2 cubic yard or more and materials that cannot be removed without systematic drilling and blasting such as rock material in ledges, bedded deposits, unstratified masses and conglomerate deposits, and below ground concrete or masonry structures, exceeding 1/2 cubic yard in volume, except that pavements will not be considered as rock.

##### 2.1.5 Unyielding Material

Unyielding material shall consist of rock and gravelly soils with stones greater than 3 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

##### 2.1.6 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

##### 2.1.7 Select Granular Material

Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a No. 200 mesh sieve and no less than 95 percent by weight passing the 1-inch sieve. The maximum allowable aggregate size shall be 1-1/2 inches, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

##### 2.1.8 Initial Backfill Material

Initial backfill shall consist of crushed stone, either KY No. 8 or No. 9. Sand or excavated material shall not be allowed.

#### 2.1.1.9 Plastic Marking Tape

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 6-inches wide with minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in TABLE 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1. Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems

### PART 3 EXECUTION

#### 3.1 EXCAVATION

Excavation shall be performed to the lines and grades indicated. Rock excavation shall include removal and disposition of material defined as rock in paragraph MATERIALS. Earth excavation shall include removal and disposal of material not classified as rock excavation. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 2 feet. Excavated material not required or not satisfactory for backfill shall be removed from the site. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph BACKFILLING AND COMPACTION at no additional cost to the Government.

##### 3.1.1 Trench Excavation

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than 5 feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter and shall not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special

installation procedures shall be borne by the Contractor without any additional cost to the Government.

#### 3.1.1.1 Bottom Preparation

The bottoms of trenches shall be overexcavated to 4 inches below the pipe and replaced with compacted initial backfill material. Material shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be shaped to the necessary size at each joint or coupling to eliminate point bearing.

#### 3.1.1.2 NOT USED

#### 3.1.1.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the fault or neglect of the Contractor in his performance of the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

#### 3.1.1.4 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures shall be sufficient to leave at least 12 inches clear between the outer structure surfaces and the face of the excavation or support members. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

#### 3.1.1.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

#### 3.1.1.6 Stockpiles

Stockpiles of satisfactory and unsatisfactory and wasted materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Government. Locations of stockpiles of satisfactory materials shall be subject to prior approval of the Contracting Officer.

### 3.2 BACKFILLING AND COMPACTION

Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as shown on plans. Bedding and initial backfill material shall be placed in layers not exceeding 6 inches loose

thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for cohesionless materials and 90 percent maximum density for cohesive materials, unless otherwise specified. Maintain moisture content during compaction within  $\pm 3\%$  of optimum.

#### 3.2.1 Trench Backfill

Trenches shall be backfilled to the grade shown. The trench shall be backfilled to 2 feet above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test.

##### 3.2.1.1 NOT USED

##### 3.2.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

##### 3.2.1.3 Bedding and Initial Backfill

Bedding and initial backfill shall consist of initial backfill material. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

##### 3.2.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways, paved, and gravelled areas, shall be filled with satisfactory material. Material shall be moistened or aerated as necessary to plus or minus 3 percent of optimum moisture. Backfill material shall be placed and compacted as follows:

a. Roadways, Paved, and Gravelled Areas: Select granular backfill shall be placed in layers of a maximum 12-inch loose thickness and compacted to 95 percent maximum density up to the elevation at which the requirements in Section C-02225 EARTHWORK FOR ROADWAYS, RAILROADS, AND AIRFIELDS control. Water flooding or jetting methods of compaction will not be permitted.

b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 12-inch loose thickness, and compacted to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

#### 3.2.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 3 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

### 3.3 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

#### 3.3.1 Gas Distribution

Trenches shall be excavated to a depth that will provide not less than 30 inches of cover. Trenches shall be graded as specified for pipe-laying requirements in Section C-02685 GAS DISTRIBUTION SYSTEM.

#### 3.3.2 Water Lines

Trenches shall be of a depth to provide a minimum cover of 30 inches from the existing ground surface, or from the indicated finished grade to the top of the pipe.

#### 3.3.3 NOT USED

#### 3.3.4 Electrical Distribution System

Direct burial cable and conduit or duct line shall have a minimum cover of 24 inches from the finished grade, unless otherwise indicated. Special trenching requirements for direct-burial electrical cables and conduits are specified in Section C-16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

#### 3.3.5 Plastic Marking Tape

Warning tapes shall be installed directly above the pipe, at a depth of 18 inches below finished grade unless otherwise shown.

### 3.4 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

#### 3.4.1 Testing Facilities

Tests shall be performed by an approved commercial testing laboratory or may be tested by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved by the Contracting Officer. The first inspection shall be at the expense of the Government. Cost incurred for any subsequent inspection required because of failure of the first inspection will be charged to the Contractor.

#### 3.4.2 Testing of Backfill Materials

Characteristics of backfill materials shall be determined in accordance with particle size analysis of soils ASTM D 422 and moisture-density relations of soils ASTM D 1557. A minimum of one particle size analysis and one moisture-density relation test shall be performed on each different type of material used for bedding and backfill.

#### 3.4.3 Field Density Tests

Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test per lift of backfill for every 100 feet of installation shall be performed. One moisture density relationship shall be determined for every 1500 cubic yards of material used. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using the sand cone method as described in paragraph Calibration of the ASTM publication. ASTM D 2922 results in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine



the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job, on each different type of material encountered, at intervals as directed by the Contracting Officer. Copies of calibration curves, results of calibration tests, and field and laboratory density tests shall be furnished to the Contracting Officer. Trenches improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to the Government.

#### 3.4.4 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to 2 feet above the top of the pipe, the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. Pipe sizes 36 inches and smaller shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgement of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

-- End of Section --

SECTION C-02513

BITUMINOUS PAVEMENT

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO T-27	(1993) Sieve Analysis of Fine and Coarse Aggregate
AASHTO T-30	(1993) Mechanical Analysis of Extracted Aggregate
AASHTO T-164	(1993) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
AASHTO T-168	(1991) R Sampling Bituminous Paving Mixtures

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C-127	(1988) Specific Gravity and Absorption of Coarse Aggregate
ASTM C-128	(1993) Specific Gravity and Absorption of Fine Aggregate
ASTM E-548	(1994) Standard Practice for Preparation of Criteria for use in the Evaluation of Testing Laboratories and Inspection Bodies

KENTUCKY DEPARTMENT OF HIGHWAYS (KDOH)

KDOH	Standard Specifications for Road and Bridge Construction - 1998
KDOH	Kentucky Methods for Testing (KM)

1.3 GENERAL

Work under this section consists of placing Bituminous Concrete Binder Course, Tack Coat, and Bituminous Concrete Surface Course. All work and materials shall conform to the applicable requirements of Section 200 through Section 800 of the Kentucky Department of Highways (KDOH) Specifications except as noted in these specifications, construction plans or contract documents. In case of difference between KDOH Specifications and the CONTRACT CLAUSES and SPECIAL CONTRACT REQUIREMENTS of this Solicitation, the CONTRACT CLAUSES and SPECIAL CONTRACT REQUIREMENTS shall govern. Measurement and Payment paragraphs and Quality Control paragraphs of KDOH shall not apply. The Contractor is responsible for

all material certification and all costs associated with certification. Load verifications shall be in accordance with 105.13 of KDOH Specifications.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittal having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTALS PROCEDURES:

##### SD-01 Data

Job Mix Formula (JMF). Aggregates; GA.  
Bituminous Material; GA.

The job mix formula, at least 14 days before it is to be used. Notification on the selection of aggregate source Notification on the selection of bituminous materials source.

##### SD-09 Reports

Aggregate Test Results; FIO.

Certified copies of aggregate test results, not less than 30 days before the material is required in the work.

##### SD-13 Certificates

Bituminous Material Manufacturer's Test Reports; FIO.

Certified copies of the bituminous material manufacturer's test reports indicating compliance with applicable specified requirements, not less than 30 days before the material is required in the work.

#### 1.4 ABBREVIATIONS AND DEFINITIONS

Standard abbreviations shall be in accordance with Section 101.01 of the KDOH Specifications. Where such terms as "Chairman," "Commission," "Engineer," or "Department" are used, they shall mean "Contracting Officer." Whenever the words "Extra Work" or similar phrase is used, it shall mean "Changes" as defined in the CONTRACT CLAUSES.

#### 1.5 NOT USED

#### 1.6 MEASUREMENT AND PAYMENT

Measurement and payment will be made part of the Lump Sum Payment for the project.

#### 1.7 SURFACING

##### 1.7.1 General

Surfacing (consisting of binder, tack coat, and surface) shall be in accordance with the plans and per the applicable sections of the KDOH Specifications, except quality control testing.

#### 1.7.2 JOB-MIX FORMULA

The Contractor shall submit to the Contracting Officer for approval five copies of the bituminous concrete job-mix formulas. The job-mix formulas shall be based on Class I mixtures.

#### 1.8 QUALITY CONTROL

##### 1.8.1 LABORATORY

The Contractor shall furnish onsite laboratory facilities sufficiently staffed and equipped to perform the testing specified. As an alternative, the Contractor may procure the services of an industry recognized laboratory. If the Contractor elects to furnish a laboratory facility, the exact location on the project site shall be subject to the approval of the Contracting Officer.

##### 1.8.2 CAPABILITY CHECK OF CONTRACTOR-FURNISHED FIELD LABORATORY

The Contracting Officer reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth herein, and to check the laboratory technicians testing procedures and techniques. The laboratory will be evaluated based on the criteria of ASTM E-548.

##### 1.8.3 CAPABILITY RE-CHECK OF CONTRACTOR-FURNISHED FIELD LABORATORY

Should the laboratory fail the capability check, the Contractor will be assessed a charge of \$1375 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory.

##### 1.8.4 USE BY GOVERNMENT OF CONTRACTOR-FURNISHED FIELD LABORATORY

The Contracting Officer reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance test and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

#### 1.9 TESTING PROGRAM

The frequency of the tests listed hereinafter is the minimum acceptable. Additional tests may be required to demonstrate compliance with the contract. The location of each test chosen shall be selected to provide adequate representation of the material being placed and to obtain the maximum coverage of each lift or layer placed. The listing of these tests does not relieve the Contractor of the responsibility for performing the infrequent tests designated in other sections of these specifications. The Contracting Officer may select the time and location for any testing required under this contract. Standards indicated in parentheses are alternate testing standards essentially equal to the first method indicated. The Contractor shall identify which standard was used when submitting test results.

# PLANT MIX ASPHALT PAVEMENTS

## Fine Aggregate

Grain Size Analysis	AASHTO T-27	Cold feed, 1 test per 3 shifts
		Hot bin, 1 test per shift
Oven Dry Bulk Specific Gravity	ASTM C-128	1 Test

## Coarse Aggregate

Grain Size Analysis	AASHTO T-27	Cold feed, 1 test per 3 shifts
		Hot bin, 1 test per shift
Oven Dry Bulk Specific Gravity	ASTM C-127	1 test

## Bituminous Mixtures

Extraction of Bitumen	Sampling AASHTO T-168 Extraction AASHTO T-164	1 test per shift
Mechanical Analysis of Extracted Aggregate	AASHTO T-30	1 test per shift
Pavement Sample (for Thickness)	Cut Full Depth from Compacted Pavement and Replace with new Material	1 per 10,000 SF
Laboratory Maximum Density	KM 64-411-89	1 test per base and 1 per surface
Field Density	KM 64-412-89	1 test per 5,000 SF per course

-- End of Section --

SECTION C-02546

AGGREGATE SURFACE COURSE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 117	(1995) Materials Finer Than 75-micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(1989) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1995a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3740	(1994a) Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

ASTM D 4318 (1993) Liquid Limit, Plastic Limit, and Plasticity Index  
of Soils

ASTM E 11 (1995) Wire-Cloth Sieves for Testing Purposes

KENTUCKY TRANSPORTATION CABINET DEPARTMENT OF HIGHWAYS, FRANKFORT,  
KENTUCKY (KDOH)

KDOH Standard Specifications for Road and Bridge Construction  
- 1998

## 1.2 NOT USED

## 1.3 DEGREE OF COMPACTION

Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated herein as present laboratory maximum density.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment; GA.

List of proposed equipment to be used in performance of construction work including descriptive data.

SD-09 Reports

Sampling and Testing; FIO.

Density Tests; FIO.

Calibration curves and related test results prior to using the device or equipment being calibrated. Copies of field test results within 24 hours after the tests are performed. Test results from samples, not less than 30 days before material is required for the work. Results of laboratory tests for quality control purposes prior to using the material.

## 1.5 EQUIPMENT

All plant, equipment, and tools used in the performance of the work covered by this section will be subject to approval by the Contracting Officer before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, and meeting the grade controls, thickness controls, and smoothness requirements set forth herein.

## 1.6 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved commercial testing laboratory or by the Contractor, subject to approval. If the Contractor elects to establish testing facilities of his own, approval of such facilities shall be based on compliance

with ASTM D 3740, and no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved.

#### 1.6.1 Sampling

Sampling for material gradation, liquid limit, and plastic limit tests shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

#### 1.6.2 Testing

The following tests shall be performed in conformance with the applicable standards listed at a frequency of one set of tests for every 1000 square yards of completed area.

##### 1.6.2.1 Gradation

Aggregate gradation shall be made in conformance with ASTM C 117, ASTM C 136, and ASTM D 422. Sieves shall conform to ASTM E 11.

##### 1.6.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

#### 1.6.3 Approval of Materials

The source of the material to be used for producing aggregates shall be selected 30 days prior to the time the material will be required in the work. Approval of sources not already approved by the Corps of Engineers will be based on an inspection by the Contracting Officer. Tentative approval of materials will be based on appropriate test results on the aggregate source. Final approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and compacted surface course.

#### 1.7 WEATHER LIMITATIONS

Aggregate surface courses shall not be constructed when the ambient temperature is below 35 degrees F and on subgrades that are frozen or contain frost. It shall be the responsibility of the Contractor to protect, by approved method or methods, all areas of surfacing that have not been accepted by the Contracting Officer. Surfaces damaged by freeze, rainfall, or other weather conditions shall be brought to a satisfactory condition by the Contractor.

### PART 2 PRODUCTS

#### 2.1 AGGREGATES

Aggregates shall consist of clean, sound, durable particles of crushed gravel, crushed stone, sand, crushed slag, or other approved materials processed and blended or naturally combined. Aggregates shall be free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign materials. The Contractor shall be responsible for obtaining materials that meet the specification and can be used to meet the grade and smoothness requirements specified herein after all compaction operations have been completed.

##### 2.1.1 Coarse Aggregates

The material retained on the No. 4 sieve shall be known as coarse aggregate. Coarse aggregates shall be reasonably uniform in density and quality. The coarse



aggregate shall have a percentage of wear not to exceed 50 percent after 500 revolutions as determined by ASTM C 131. The amount of flat and/or elongated particles shall not exceed 20 percent. A flat particle is one having a ratio of width to thickness greater than three; an elongated particle is one having a ratio of length to width greater than three. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the requirements set forth herein.

#### 2.1.2 Fine Aggregates

The material passing the No. 4 sieve shall be known as fine aggregate. Fine aggregate shall consist of screenings, sand, or other finely divided mineral matter that is processed or naturally combined with the coarse aggregate.

#### 2.1.3 Gradation Requirements

Gradation requirements specified in TABLE I shall apply to the completed aggregate surface. It shall be the responsibility of the Contractor to obtain materials that will meet the gradation requirements after mixing, placing, compacting, and other operations. TABLE I shows permissible gradings for granular material used in aggregate surface areas and shoulders. Sieves shall conform to ASTM E 11.

TABLE I. GRADATION FOR AGGREGATE SURFACE COURSES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	KY No. 610
1 1/2 inch	100
1	85-100
3/4	----
1/2	40-75
3/8	----
No. 4	15-40
No. 8	----

NOTE 1: Particles having diameters less than 0.02 mm shall not be in excess of 12 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity, and the percentages passing the various sieves may require appropriate correction by the Contracting Officer when aggregates of varying specific gravities are used.

#### 2.1.4 Liquid Limit and Plasticity Index

The portion of the completed aggregate surface course passing the No. 40 sieve shall have a maximum liquid limit of 35 and a plasticity index of 4 to 9.

### PART 3 EXECUTION

#### 3.1 OPERATION OF AGGREGATE SOURCES

Clearing, stripping, and excavating shall be the responsibility of the Contractor. The aggregate sources shall be operated to produce the quantity and quality of materials meeting these specification requirements in the specified

time limit. Upon completion of the work, the aggregate sources on Government reservations shall be conditioned to drain readily and be left in a satisfactory condition. Aggregate sources on private lands shall be conditioned in agreement with local laws or authorities.

### 3.2 STOCKPILING MATERIALS

Prior to stockpiling the material, the storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled in such a manner that will prevent segregation. Aggregates and binders obtained from different sources shall be stockpiled separately.

### 3.3 PREPARATION OF UNDERLYING COURSE SUBGRADE

The underlying course or subgrade shall be cleaned of all foreign substances. At the time of surface course construction, the underlying course or subgrade shall contain no frozen material. Ruts or soft yielding spots in the underlying course or subgrade, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade and recompact to density requirements specified in Section C-02225 EARTHWORK FOR ROADWAYS, PAVEMENT AND AIRFIELDS and C-02233 GRADED-CRUSHED-AGGREGATE BASE COURSE. The completed underlying course or subgrade shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the surface course is placed.

### 3.4 GRADE CONTROL

During construction, the lines and grades including crown and cross slope indicated for the aggregate surface course and shoulders shall be maintained by means of line and grade stakes placed by the Contractor in accordance with the SPECIAL CLAUSES.

### 3.5 MIXING AND PLACING MATERIALS

The materials shall be mixed in a twin shaft pugmill type mixer and placed in such a manner as to obtain uniformity of the material and at a uniform optimum water content for compaction. The Contractor shall make such adjustments in mixing or placing procedures or in equipment so as to obtain the true grades, to minimize segregation and degradation, to obtain the desired water content, and to ensure a satisfactory surface course.

### 3.6 LAYER THICKNESS

The aggregate material shall be placed on the underlying course or subgrade in layers of uniform thickness. When a compacted layer of 6 inches or less is specified, the material may be placed in a single layer; when a compacted thickness of more than 6 inches is required, no layer shall exceed 6 inches nor be less than 3 inches when compacted.

### 3.7 COMPACTION

Each layer of the aggregate surface course shall be compacted with approval compaction equipment. The water content during the compaction procedure shall be maintained at optimum or at the percentage specified by the Contracting Officer. In locations not accessible to the rollers, the mixture shall be compacted with mechanical tampers. Compaction shall continue until each layer

through the full depth is compacted to at least 95 percent of laboratory maximum density. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked to produce a satisfactory material.

### 3.8 NOT USED

### 3.9 EDGES OF AGGREGATE-SURFACED ROAD

Approved material shall be placed along the edges of the aggregate surface course in such quantity as to compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, at least 1 foot of shoulder width shall be rolled and compacted simultaneously with the rolling and compacting of each layer of the surface course.

### 3.10 SMOOTHNESS TEST

The surface of each layer shall not show any deviations in excess of 3/8 inch when tested with a 10-foot straightedge applied both parallel with and at right angles to the centerline of the area to be paved. Deviations exceeding this amount shall be corrected by the Contractor by removing material, replacing with new material, or reworking existing material and compacting, as directed.

### 3.11 THICKNESS CONTROL

The completed thickness of the aggregate surface course shall be within 1/4-inch plus or minus, of the thickness indicated on plans. The thickness of the aggregate surface course shall be measured at intervals in such manner that there will be a thickness measurement for at least each 500 square yards of the aggregate surface course. The thickness measurement shall be made by test holes at least 3 inches in diameter through the aggregate surface course. When the measured thickness of the aggregate surface course is more than 1/4-inch deficient in thickness, the Contractor, at no additional expense to the Government, shall correct such areas by scarifying, adding mixture of proper gradation, reblading, and recompacting, as directed. Where the measured thickness of the aggregate surface course is more than 1/4-inch thicker than that indicated, it shall be considered as conforming with the specified thickness requirements plus 1/4 inch. The average job thickness shall be the average of the job measurements determined as specified above, but shall be within 1/4 inch of the thickness indicated. When the average job thickness fails to meet this criterion, the Contractor shall, at no additional expense to the Government, make corrections by scarifying, adding or removing mixture of proper gradation, and reblading and recompacting, as directed.

### 3.12 DENSITY TESTS

Density shall be measured in the field in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. For the method presented in ASTM D 2922 the calibration curves shall be checked and adjusted, if necessary, using only the sand cone method as described in paragraph Calibration of the ASTM publication. Tests performed in accordance with ASTM D 2922 result in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration of ASTM D 2922, on each different type of material being tested at the beginning of a job and at intervals, as directed.

### 3.13 WEAR TEST

Wear tests shall be made in conformance with ASTM C 131.

### 3.14 MAINTENANCE

The aggregate surface course shall be maintained in a condition that will meet all specification requirements until accepted.

-- End of Section --

SECTION C-02580

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS(AASHTO)

AASHTO M 247 (1981; Rev 1986) Glass Beads Used in Traffic Paint  
AASHTO M 248 (1991I) Ready-Mixed White and Yellow Traffic Paints

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 792 (1991) Density and Specific Gravity  
(Relative Density) of Plastics by  
Displacement  
ASTM D 4280 (1995) Extended Life Type, Nonplowable, Prismatic,  
Raised, Retroreflective Pavement Markers  
ASTM D 4505 (1992) Preformed Plastic Pavement Marking Tape for  
Extended Service Life  
ASTM E 28 (1992) Softening Point by  
Ring-and-Ball Apparatus

FEDERAL SPECIFICATIONS (FS)

FS TT-P-85 (Rev E) Paint, Traffic and Airfield  
Marking, Solvent Base  
FS TT-P-115 (Rev F) Paint, Traffic (Highway, White,  
and Yellow)

FEDERAL STANDARDS (FED-STD)

FED-STD 595 (Rev B) Colors Used in Government  
Procurement

1.2 NOT USED

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-09 Reports

Material Tests; FIO.

Certified copies of the test reports, prior to the use of the materials at the jobsite. Testing shall be performed in an approved independent laboratory.

#### 1.4 DELIVERY AND STORAGE

All materials shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, and directions, all of which shall be plainly legible at time of use.

#### 1.5 EQUIPMENT

All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition. Equipment operating on roads and runways will display low speed traffic markings and traffic warning lights. Hand-operated push-type machines of a type commonly used for application of paint to pavement surfaces shall be acceptable for marking small streets and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. Sandblasting equipment shall be provided as required for cleaning surfaces to be painted. Hand-operated spray guns shall be provided for use in areas where push-type machines cannot be used.

##### 1.5.1 NOT USED

##### 1.5.2 NOT USED

##### 1.5.3 NOT USED

##### 1.5.4 NOT USED

##### 1.5.5 NOT USED

##### 1.5.6 Traffic Controls

Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment in operation.

##### 1.6 NOT USED

#### PART 2 PRODUCTS

##### 2.1 PAINT

The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of 6 months. Paint for roads and streets shall conform to FS TT-P-115, color as indicated.

##### 2.2 NOT USED

##### 2.3 NOT USED

##### 2.4 NOT USED

##### 2.5 NOT USED

##### 2.6 NOT USED

## PART 3 EXECUTION

### 3.1 SURFACE PREPARATION

Surfaces to be marked shall be thoroughly cleaned before application of the pavement marking material. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed. Areas of old pavement affected with oil or grease shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping or marking. Surfaces shall be recleaned, when work has been stopped due to rain.

#### 3.1.1 NOT USED

#### 3.1.2 NOT USED

#### 3.1.3 Cleaning Concrete Curing Compounds

On new portland cement concrete pavements, cleaning operations shall not begin until a minimum of 30 days after the placement of concrete. All new concrete pavements shall be cleaned by either sandblasting or water blasting. When water blasting is performed, thermoplastic and preformed markings shall be applied no sooner than 24 hours after the blasting has been completed. The extent of the blasting work shall be to clean and prepare the concrete surface as follows:

a. There is no visible evidence of curing compound on the peaks of the textured concrete surface.

b. There are no heavy puddled deposits of curing compound in the valleys of the textured concrete surface.

c. All remaining curing compound is intact; all loose and flaking material is removed.

d. The peaks of the textured pavement surface are rounded in profile and free of sharp edges and irregularities.

e. The surface to be marked is dry.

### 3.2 APPLICATION

All pavement markings and patterns shall be placed as shown on the plans.

#### 3.2.1 Paint

Paint shall be applied to clean, dry surfaces, and only when air and pavement temperatures are above 40 degrees F and less than 95 degrees F. Paint temperature shall be maintained within these same limits. New asphalt pavement surfaces and new portland cement concrete shall be allowed to cure for a period of not less than 30 days before applications of paint. Paint shall be applied pneumatically with approved equipment at rate of coverage specified herein. The Contractor shall provide guide lines and templates as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols. Edges of markings shall be sharply outlined.

##### 3.2.1.1 Rate of Application

Nonreflective Markings: Paint shall be applied evenly to the pavement surface to be coated at a rate of 105 plus or minus 5 square feet per gallon.

3.2.1.2 Drying

The maximum drying time requirements of the paint specifications will be strictly enforced to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a delay in drying of the markings, painting operations shall be discontinued until cause of the slow drying is determined and corrected.

3.2.2 NOT USED

3.2.3 NOT USED

3.2.4 NOT USED

3.2.5 NOT USED

-- End of Section --



SECTION C-02660

WATER LINES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 88 (1993a) Seamless Copper Water Tube

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA C104	(1990) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	(1988) Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
AWWA C110	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids
AWWA C111	(1990) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151	(1991) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C153	(1994) Ductile-Iron Compact Fittings, 3 In. Through 16 In., for Water and Other Liquids
AWWA C500	(1993) Gate Valves for Water and Sewerage Systems
AWWA C502	(1985) Dry-Barrel Fire Hydrants
AWWA C509	(1994) Resilient-Seated Gate Valves for Water and Sewerage Systems
AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C651	(1992) Disinfecting Water Mains
AWWA C800	(1989) Underground Service Line Valves and Fittings
AWWA M23	(1980) Manual: PVC Pipe - Design and Installation

ASBESTOS CEMENT PIPE PRODUCERS ASSOCIATION (ACPPA)

ACPPA-01 (1988) Recommended Work Practices for A/C Pipe

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA-01 (1992; Errata May 1993) Thrust Restraint Design for Ductile Iron Pipe

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80 (1987) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24 (1992) Installation of Private Fire Service Mains and Their Appurtenances

NFPA 49 (1991) Hazardous Chemicals Data

NFPA 325M (1991) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids

NFPA 704 (1990) Identification of the Fire Hazards of Materials

NFPA 1961 (1992) Fire Hose

NSF INTERNATIONAL (NSF)

NSF Std 14 (1965; Rev Nov 1990) Plastics Piping System Components and Related Materials

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 21 (1991) White or Colored Silicone Alkyd Paint

SSPC Paint 25 (1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (without Lead and Chromate Pigments)

## 1.2 PIPING

This section covers water distribution and service lines, and connections to building service at a point approximately 5 feet outside buildings and structures to which service is required. The Contractor shall have a copy of the manufacturer's recommendations for each material or procedure to be utilized available at the construction site at all times.

### 1.2.1 Service Lines

Piping for water service lines less than 3 inches in diameter shall be copper tubing. Piping for water service lines for sizes 3 inches and larger shall be ductile iron.

#### 1.2.2 Distribution Lines 3 Inches or Larger

Piping for water distribution lines 3 inches or larger shall be ductile iron.

#### 1.2.3 NOT USED

#### 1.2.4 Sprinkler Supply Lines

Piping for water lines supplying sprinkler systems for building fire protection shall conform to NFPA 24 from the point of connection with the water distribution system to the building 5 foot line.

#### 1.2.5 NOT USED

#### 1.2.6 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section C-02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

#### 1.3 NOT USED

#### 1.4 NOT USED

#### 1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-06 Instructions

Installation; FIO.

The manufacturer's recommendations for each material or procedure to be utilized.

##### SD-08 Statements

Waste Water Disposal Method; FIO.

The method proposed for disposal of waste water from hydrostatic tests and disinfection, prior to performing hydrostatic tests.

Statement of Satisfactory Installation; FIO.

A statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in accordance with the contract plans and specifications and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

##### SD-09 Reports

Bacterial Examination; FIO.

Test results from commercial laboratory verifying disinfection.

#### 1.6 HANDLING

Pipe and accessories shall be handled so as to insure delivery to the trench in sound, undamaged condition. Particular care shall be taken not to injure the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor at his expense in a

satisfactory manner. No other pipe or material of any kind shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place.

#### 1.6.1 Coated and Wrapped Steel Pipe

Coated and wrapped steel pipe shall be handled in conformance with AWWA C203.

#### 1.6.2 NOT USED

#### 1.6.3 NOT USED

### PART 2 PRODUCTS

#### 2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

##### 2.1.1 NOT USED

##### 2.1.2 NOT USED

##### 2.1.2.1 NOT USED

##### 2.1.2.2 NOT USED

##### 2.1.3 NOT USED

##### 2.1.4 NOT USED

##### 2.1.5 Ductile-Iron Pipe

Ductile-iron pipe shall conform to AWWA C151, working pressure not less than 150 psi, unless otherwise shown or specified. Pipe shall be cement-mortar lined in accordance with AWWA C104. Linings shall be standard. When installed underground, pipe shall be encased with 8 mil thick polyethylene in accordance with AWWA C105. Flanged ductile iron pipe with threaded flanges shall be in accordance with AWWA C115.

##### 2.1.6 NOT USED

##### 2.1.7 Copper Tubing

Copper tubing shall conform to ASTM B 88, Type K, annealed.

#### 2.2 FITTINGS AND SPECIALS

##### 2.2.1 NOT USED

##### 2.2.2 NOT USED

##### 2.2.3 NOT USED

#### 2.2.4 Ductile-Iron Pipe

Fittings and special shall be suitable for 150 psi pressure rating, unless otherwise specified. Fittings and specials for mechanical joint pipe shall conform to AWWA C110. Fittings and specials for use with push-on joint pipe shall conform to AWWA C110 and AWWA C111. Fittings and specials for grooved and shouldered end pipe shall conform to AWWA C606. Fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Ductile iron compact fittings shall conform to AWWA C153.

#### 2.2.5 NOT USED

#### 2.2.6 Copper Tubing

Fittings and specials shall be flared and conform to ASME B16.26.

### 2.3 JOINTS

#### 2.3.1 NOT USED

#### 2.3.2 NOT USED

#### 2.3.3 NOT USED

#### 2.3.4 NOT USED

#### 2.3.5 Ductile-Iron Pipe

a. Mechanical joints shall be of the stuffing box type and shall conform to AWWA C111.

b. Push-on joints shall conform to AWWA C111.

c. Rubber gaskets and lubricant shall conform to the applicable requirements of AWWA C111.

#### 2.3.6 NOT USED

#### 2.3.7 NOT USED

#### 2.3.8 NOT USED

#### 2.3.9 Copper Tubing

Joints shall be compression-pattern flared and shall be made with fittings hereinafter specified.

### 2.4 VALVES

#### 2.4.1 NOT USED

#### 2.4.2 Gate Valves

Gate valves shall be designed for a working pressure of not less than 150 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

a. Valves smaller than 3 inches shall be all bronze and shall conform to MSS SP-80, Type 1, Class 150.

b. Valves 3 inches and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.

c. Resilient-Seated Gate Valves: For valves 3 to 12 inches in size, resilient-seated gate valves shall conform to AWWA C509.

2.4.3 NOT USED

2.4.4 NOT USED

2.4.5 NOT USED

2.4.6 Indicator Post for Valves

Each valve shown on the drawings with the designation "P.I.V." shall be equipped with indicator post conforming to the requirements of NFPA 24. Operation shall be by a wrench which will be attached to each post.

## 2.5 VALVE BOXES

Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "WATER" shall be cast in the cover. The box length shall adapt, without full extension, to the depth of cover required over the pipe at the valve location.

2.6 NOT USED

## 2.7 FIRE HYDRANTS

Hydrants shall be dry-barrel type conforming to AWWA C502 with valve opening at least 5 inches in diameter and designed so that the flange at the main valve seat can be removed with the main valve seat apparatus remaining intact, closed and reasonably tight against leakage and with a breakable valve rod coupling and breakable flange connections located no more than 8 inches above the ground grade. Hydrants shall have a 6 inch bell connection, two 1/2 inch hose connections and one 4-1/2 inch pumper connection. Outlets shall have American National Standard fire-hose coupling threads. Working parts shall be bronze. Design, material, and workmanship shall be similar and equal to the latest stock pattern ordinarily produced by the manufacturer. Hydrants shall be painted with one coat of red iron oxide, zinc oxide primer conforming to SSPC Paint 25 and two finish coats of silicone alkyd paint conforming to SSPC Paint 21, of the color directed. Suitable bronze adapter for each outlet, with caps, shall be furnished.

2.8 NOT USED

## 2.9 MISCELLANEOUS ITEMS

2.9.1 NOT USED

2.9.2 NOT USED

2.9.3 NOT USED

2.9.4 NOT USED

2.9.5 NOT USED

2.9.6 NOT USED

2.9.7 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

2.9.8 NOT USED

2.9.9 NOT USED

2.10 NOT USED

### PART 3 EXECUTION

#### 3.1 INSTALLATION

##### 3.1.1 Cutting of Pipe

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable. Copper tubing shall be cut square and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

##### 3.1.2 Adjacent Facilities

###### 3.1.2.1 Sewer Lines

Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 10 feet from a sewer except where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 6 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe for a distance of at least 10 feet on each side of the crossing shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet horizontally of the crossing.

###### 3.1.2.2 Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

###### 3.1.2.3 Copper Tubing

Copper tubing shall not be installed in the same trench with ferrous piping materials.

###### 3.1.2.4 NOT USED

###### 3.1.2.5 NOT USED

###### 3.1.2.6 NOT USED

##### 3.1.3 Joint Deflection

###### 3.1.3.1 NOT USED

3.1.3.2 NOT USED

3.1.3.3 Ductile-Iron Pipe

The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

3.1.3.4 NOT USED

3.1.4 Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Under no circumstances shall any of the water-line materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

3.1.4.1 NOT USED

3.1.4.2 Plastic Pipe Installation

PVC shall be installed in accordance with AWWA M23.

3.1.4.3 Connections

Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. Where made under pressure, these connections shall be installed using standard methods as approved by the Contracting Officer.

3.1.4.4 NOT USED

3.1.4.5 NOT USED

3.1.5 Jointing

3.1.5.1 NOT USED

3.1.5.2 NOT USED

3.1.5.3 NOT USED

3.1.5.4 NOT USED

3.1.5.5 Ductile-Iron Pipe

Mechanical and push-on type joints shall be installed in accordance with AWWA C600 for buried lines.



3.1.5.6 NOT USED

3.1.5.7 NOT USED

3.1.5.8 Copper Tubing

Joints shall be made with flared fittings. The flared end tube shall be pulled tightly against the tapered part of the fitting by a nut which is part of the fitting, so there is metal-to-metal contact.

3.1.5.9 NOT USED

3.1.5.10 NOT USED

3.1.5.11 Connections

Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer.

3.1.6 Service Lines

Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately 5 feet outside the building where such building service exists. Where building services are not installed, the Contractor shall terminate the service lines approximately 5 feet from the site of the proposed building at a point designated by the Contracting Officer. Such service lines shall be closed with plugs or caps.

3.1.6.1 NOT USED

3.1.6.2 NOT USED

3.1.6.3 NOT USED

3.1.6.4 Service Lines Larger than 2 Inches

Service lines larger than 2 inches shall be connected to the main by a tee or reducing tee and reducers as needed, depending on the main diameter and the service line diameter, and shall have a gate valve.

3.1.6.5 Service Lines for Sprinkler Supplies

Water service lines used to supply building sprinkler systems for fire protection shall be connected to the water distribution main in accordance with NFPA 24.

3.1.7 NOT USED

3.1.8 Setting of Fire Hydrants, Valves and Valve Boxes

3.1.8.1 Fire Hydrants

Fire hydrants shall be located and installed as shown. Each hydrant shall be connected to the main with a 6 inch branch line having at least as much cover as the distribution main. Hydrants shall be set plumb with pumper nozzle facing the roadway, with the center of the lowest outlet not less than 18 inches above the finished surrounding grade, and the operating nut not more than 48 inches above the finished surrounding grade. Except where approved otherwise, the backfill around hydrants shall be thoroughly compacted to the finished gradeline immediately after installation to obtain beneficial use of the hydrant as soon as practicable. The hydrant shall be set upon a slab of concrete not less than

4 inches thick and 15 inches square. Not less than 7 cubic feet of free-draining broken stone or gravel shall be placed around and beneath the waste opening of dry barrel hydrants to ensure drainage.

3.1.8.2 NOT USED

3.1.8.3 Valves

After delivery, valves, including those in hydrants, shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and hydrants and valves shall be fully opened and fully closed to ensure that all parts are in working condition. Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be carefully tamped around each valve box or pit to a distance of 4 feet on all sides of the box, or the undisturbed trench face if less than 4 feet.

3.1.8.3 NOT USED

3.1.9 NOT USED

3.1.10 Thrust Restraint

Plugs, caps, tees and bends deflecting 11-1/4 degrees or more, either vertically or horizontally, on waterlines except solvent cement jointed PVC, and fire hydrants shall be provided with thrust restraints. Valves shall be securely anchored or shall be provided with thrust restraints to prevent movement. Thrust restraints shall be either thrust blocks or, for ductile-iron pipes, restrained joints.

3.1.10.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2,000 psi after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.10.2 Restrained Joints

For ductile-iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA-01.

3.2 HYDROSTATIC TESTS

Where any section of a water line is provided with concrete thrust blocking for fitting or hydrants, the hydrostatic tests shall not be made until at least 5 days after installation of the concrete thrust blocking, unless otherwise approved.

3.2.1 Pressure Test

After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for

examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, hydrants, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves, discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions is encountered:

- a. Wet or unstable soil conditions in the trench.
- b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.
- c. Maintaining the trench in an open condition would delay completion of the contract.

The Contractor may request a waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of Section C-02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

### 3.2.2 Leakage Test

Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to not less than 200 psi pressure. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

$$L = 0.0001351ND(P \text{ raised to } 1/2 \text{ power})$$

L = Allowable leakage in gallons per hour N = Number of joints in the length of pipeline tested D = Nominal diameter of the pipe in inches P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

### 3.2.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Cement mortar lined pipe may be filled with water as recommended by the manufacturer before being subjected to the pressure test and subsequent leakage test.

### 3.2.4 Concurrent Hydrostatic Tests

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be satisfactory as specified. All replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government.

a. Pressure test and leakage test may be conducted concurrently.

b. Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be reaccomplished.

### 3.3 DISINFECTION

#### 3.3.1 Bacteriological Disinfection

Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as prescribed by Tennessee State Standards. The unit will not be accepted until satisfactory bacteriological results have been obtained.

#### 3.3.2 NOT USED

### 3.4 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

SECTION C-02685

GAS DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN GAS ASSOCIATION (AGA)

AGA-01 (1989) A.G.A. Plastic Pipe Manual for Gas Service

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B109.2 (1992) Diaphragm Type Gas Displacement Meters (Over 500 Cubic Feet per Hour Capacity)

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 5L (1995) Line Pipe

API Spec 6D (1994 Supple June 1996) Specification for Pipeline Valves, (Gate, Plug, Ball, and Check Valves)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53 (1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

ASTM A 181 (1995b) Forgings, Carbon Steel, for General-Purpose Piping

ASTM D 2513 (1995c) Thermoplastic Gas Pressure Pipe, Tubing, and Fittings

ASTM D 2683 (1993) Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

ASTM D 3261 (1993) Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

ASTM D 3350 (1993) Polyethylene Plastics Pipe and Fittings Materials

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1 (1983; R 1992) Pipe Threads, General Purpose (Inch)

ASME B16.5 (1988; Errata Oct 1988; B16.5a) Pipe Flanges and Flanged Fittings

ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1991) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.34	(1988) Valves-Flanged, Threaded, and Welding End
ASME B16.40	(1985; R 1994) Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems
ASME B31.1	(1992; B31.1a) Power Piping
ASME B31.8	(1995) Gas Transmission and Distribution Piping Systems
ASME BPV VIII Div 1	(1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME BPV IX	(1992; Addenda Dec 1992) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

#### CODE OF FEDERAL REGULATIONS (CFR)

49 CFR 192	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards
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#### MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1993) Standard Marking System for Valves, Fittings, Flanges and Unions
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#### NACE INTERNATIONAL (NACE)

NACE RP0185	(1985) Extruded, Polyolefin Resin Coating Systems for Underground or Submerged Pipe
NACE RP0274 (1993)	High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation

#### STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 21	(1991) White or Colored Silicone Alkyd Paint
SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)
SSPC Paint 101	(1991) Aluminum Alkyd Paint
SSPC Paint 104	(1991) White or Tinted Alkyd Paint

SSPC SP 1 (1982) Solvent Cleaning  
SSPC SP 3 (1995) Power Tool Cleaning  
SSPC SP 6 (1994) Commercial Blast Cleaning  
SSPC SP 7 (1994) Brush-Off Blast Cleaning

UNDERWRITERS LABORATORIES (UL)

UL-06 (1996) Gas and Oil Equipment Directory

1.2 GENERAL REQUIREMENTS

1.2.1 Welding Steel Piping

Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with Section IX of ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified at least 24 hours in advance of tests and the tests shall be performed at the work site if practicable. The Contracting Officer shall be furnished with a copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section C-05055 WELDING, STRUCTURAL.

1.2.2 Jointing Polyethylene Piping

Piping shall be joined by performance qualified joiners using qualified procedures in accordance with AGA-01. Manufacturer's prequalified joining procedures shall be used. Joints shall be inspected by an inspector qualified in the joining procedures being used and in accordance with AGA-01. Joiners and inspectors shall be qualified at the job site by a person who has been trained and certified by the manufacturer of the pipe, to train and qualify joiners and inspectors in each joining procedure to be used on the job. Training shall include use of equipment, explanation of the procedure, and successfully making joints which pass tests specified in AGA-01. The Contracting Officer shall be notified at least 24 hours in advance of the date to qualify joiners and inspectors.

1.2.3 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos shall not be used. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. Valves, flanges, and fittings shall be marked in accordance with MSS SP-25.

1.2.4 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

#### 1.2.5 Handling

Pipe and components shall be handled carefully to ensure a sound, undamaged condition. Particular care shall be taken not to damage pipe coating. No pipe or material of any kind shall be placed inside another pipe or fitting after the coating has been applied, except as specified in paragraph INSTALLATION. Plastic pipe shall be handled in conformance with AGA-01.

#### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-04 Drawings

Pipe, Fittings, and Associated Materials; FIO.

Drawings shall contain complete schematic and piping diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of the system and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

##### SD-07 Schedules

Equipment and Materials; FIO.

A complete list of equipment and materials, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions, including, but not limited to the following:

- a. Dielectric Unions and Flange Kits.
- b. Meters.
- c. Pressure Reducing Valves.
- d. Regulators.

Spare Parts Data; FIO.

Spare parts lists for each different item of material and equipment specified, after approval of the detail drawings and not later than 3 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

Notification; FIO.

Notification of the Contractor's schedule for making connections to existing gas lines, at least 10 days in advance.

##### SD-08 Statements

Welding Steel Piping; FIO.

A copy of qualified welding procedures along with a list of names and identification symbols of performance qualified welders and welding operators.

Jointing Polyethylene Piping; GA.



A copy of qualified jointing procedures, training procedures, qualifications of trainer, and training test results for joiners and inspectors.

Connection and Abandonment Procedures; GA.

A copy of procedures for gas line tie in, hot taps, abandonment/removal or demolition, purging, and plugging as applicable in accordance with ASME B31.8.

#### SD-09 Reports

Test Results; FIO.

Provide results of pressure testing of final system installation as described in Section 3.14.

#### SD-13 Certificates

Training; FIO.

A copy of each inspector's and joiner's training certificate with respective test results.

#### SD-19 Operation and Maintenance Manuals

Gas Distribution System; GA.

Operating Instructions: The Contractor shall furnish the Contracting Officer with six complete copies of operating instructions outlining the step-by-step procedures required for system start up, operation, and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features.

Maintenance Instructions: The Contractor shall furnish the Contracting Officer with six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The instructions shall include piping layout, equipment layout, and control diagrams of the system as installed.

## PART 2 PRODUCTS

### 2.1 PIPE, FITTINGS, AND ASSOCIATED MATERIALS

#### 2.1.1 Steel Pipe

Steel pipe shall conform to ASTM A 53, Grade A or B, Type E or S, Schedule 40; or API Spec 5L seamless or electric resistance welded, Schedule 40; black, as specified in ASME B31.8. Furnace butt welded pipe may be used in sizes 1-1/2 inches and smaller.

#### 2.1.2 Small Fittings

Fittings 1-1/2 inches and smaller shall conform to ASME B16.11.

#### 2.1.3 Fittings, 2 Inches and Larger

Pipe flanges and flanged fittings including bolts, nuts, and bolt patterns shall be in accordance with ASME B16.5, Class 150. Butt welded fittings shall be in accordance with ASME B16.9. Weld neck flanges shall be used.

#### 2.1.4 Steel Forged Branch Connections

Connections shall conform to ASTM A 181, Class 60, carbon steel.

#### 2.1.5 Flange Gaskets

Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch minimum thickness, full face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with nitrile butadiene rubber (NBR), or glass fibers bonded with polytetrafluorethylene, suitable for maximum 600 degrees F service and meeting applicable requirements of ASME B31.8.

#### 2.1.6 Pipe Threads

Pipe threads shall conform to ASME B1.20.1.

#### 2.1.7 Polyethylene Pipe, Tubing, Fittings and Joints

Polyethylene pipe, tubing, fittings and joints shall conform to ASTM D 3350 and ASTM D 2513, pipe designation PE 3408, rated SDR 21 or less, as specified in ASME B31.8. Pipe sections shall be marked as required by ASTM D 2513. Butt fittings shall conform to ASTM D 3261 and socket fittings shall conform to ASTM D 2683. Fittings shall match the service rating of the pipe.

#### 2.1.8 NOT USED

#### 2.1.9 Sealants for Steel Pipe Threaded Joints

##### 2.1.9.1 Sealing Compound

Joint sealing compound shall be as listed in UL-06, Class 20 or less.

##### 2.1.9.2 Tape

Polytetrafluoroethylene tape shall conform to ASTM D 3308.

##### 2.1.10 Identification

Pipe flow markings and metal tags for each valve, meter, and regulator shall be provided as required by the Contracting Officer.

##### 2.1.11 Insulating Joint Materials

Insulating joint materials shall be provided between flanged or threaded metallic pipe systems where shown to isolate galvanic or electrolytic action.

###### 2.1.11.1 Threaded Joints

Joints for threaded pipe shall be steel body nut type dielectric type unions with insulating gaskets.

###### 2.1.11.2 Flanged Joints

Joints for flanged pipe shall consist of full face sandwich-type flange insulating gasket of the dielectric type, insulating sleeves for flange bolts and insulating washers for flange nuts.

##### 2.1.12 Gas Transition Fittings

Gas transition fittings shall be manufactured steel fittings approved for jointing steel and polyethylene pipe. Approved transition fittings are those that conform to AGA-01 requirements for transition fittings.

## 2.2 VALVES

Valves shall be suitable for shutoff or isolation service and shall conform to the following:

### 2.2.1 Steel Valves

Steel valves 1-1/2 inches and smaller installed underground shall conform to ASME B16.34, carbon steel, socket weld ends, with square wrench operator adaptor. Steel valves 1-1/2 inches and smaller installed aboveground shall conform to ASME B16.34 carbon steel, socket weld or threaded ends with handwheel or wrench operator. Steel valves 2 inches and larger installed underground shall conform to API Spec 6D, carbon steel, butt weld ends, Class 150 with square wrench operator adaptor. Steel valves 2 inches and larger installed aboveground shall conform to API Spec 6D, carbon steel, butt weld or flanged ends, Class 150 with handwheel or wrench operator.

### 2.2.2 NOT USED

### 2.2.3 Polyethylene Valves

Polyethylene valves shall conform to ASME B16.40. Polyethylene valves, in sizes 1/2-inch to 6 inches, may be used with polyethylene distribution and service lines, in lieu of steel valves, for underground installation only.

## 2.3 PRESSURE REGULATORS

Regulators shall have ferrous bodies, shall provide backflow and vacuum protection, and shall be designed to meet the pressure, load and other service conditions.

### 2.3.1 NOT USED

### 2.3.2 Service Line Regulators

Pressure regulators for individual service lines shall have ferrous bodies. Regulator shall be capable of reducing distribution line pressure to pressures required for users. Regulators shall be provided where gas will be distributed at pressures in excess of 10 inches of water column. Pressure relief shall be set at a lower pressure than would cause unsafe operation of any connected user. Regulator shall have single port with orifice diameter no greater than that recommended by the manufacturer for the maximum gas pressure at the regulator inlet. Regulator valve vent shall be of resilient materials designed to withstand flow conditions when pressed against the valve port. Regulator shall be capable of regulating downstream pressure within limits of accuracy and shall be capable of limiting the buildup of pressure under no-flow conditions to 50 percent or less of the discharge pressure maintained under flow conditions. Regulator shall have a self contained service regulator. Regulator pipe connections shall not exceed 2 inch size.

## 2.4 METERS

Meters shall conform to ANSI B109.2. Meters shall be pipe mounted and be provided with a strainer immediately upstream. Meters shall be provided with over-pressure, backflow, and vacuum protection as specified in ASME B31.8.

Meters shall be suitable for accurately measuring and handling gas at pressures, temperatures, and flow rates indicated.

## 2.5 NOT USED

## 2.6 PROTECTIVE COVERING MATERIALS

### 2.5.1 Thermoplastic Resin Coating System

Continuously extruded polyethylene and adhesive coating system materials shall conform to NACE RP0185, Type A.

## 2.7 NOT USED

# PART 3 EXECUTION

## 3.1 EXCAVATION AND BACKFILLING

Earthwork shall be as specified in Section C-02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Plastic marking tape shall be provided for all gas lines as specified in Section C-02316, Para. 2.1.9 and 3.3.5.

## 3.2 GAS MAINS

Pipe for gas mains shall be polyethylene. Polyethylene mains shall not be installed aboveground.

## 3.3 SERVICE LINES

Underground service lines shall be polyethylene pipe. Service lines shall extend from a gas main to and including the point of delivery within 5 feet of the building. The point of delivery is the discharge of the meter set, regulator, and shutoff valve assembly. The service lines shall be connected to the gas mains using standard polyethylene pipe fittings. Where indicated, service line shall be provided with an isolation valve of the same size as the service line. The service lines shall be as short and as straight as practicable between the point of delivery and the gas main and shall not be bent or curved laterally unless necessary to avoid obstructions or otherwise permitted. Service lines shall be laid with as few joints as practicable using standard lengths of pipe. Shorter lengths shall be used only for closures. Polyethylene service lines shall not be installed aboveground except as permitted in ASME B31.8. The length of service line from the underground transition fitting to the service line shutoff valve above grade shall be steel pipe with a bituminous tape protective covering as specified herein.

## 3.4 WORKMANSHIP AND DEFECTS

Pipe, tubing, and fittings shall be clear and free of cutting burrs and defects in structure or threading and shall be thoroughly brushed and blown free of chips and scale. Defective pipe, tubing, or fittings shall be replaced and shall not be repaired.

### 3.5 PROTECTIVE COVERING

#### 3.5.1 Protective Covering for Underground Steel Pipe

This specification also applies to steel casing pipe for plastic gas mains. Except as otherwise specified, protective coverings shall be applied mechanically in a factory or field plant especially equipped for the purpose. Valves and fittings that cannot be coated and wrapped mechanically shall have the protective covering applied by hand, preferably at the plant that applies the covering to the pipe. Joints shall be coated and wrapped by hand. Hand coating and wrapping shall be done in a manner and with materials that will produce a covering equal in thickness to that of the covering applied mechanically.

##### 3.5.1.1 Thermoplastic Resin Coating System

Joint coating and field repair material shall be applied as recommended by the coating manufacturer and shall be one of the following:

- a. Polyvinyl chloride pressure-sensitive adhesive tape.
- b. High density polyethylene/bituminous rubber compound tape.

The coating system shall be inspected for holes, voids, cracks, and other damage during installation.

##### 3.5.1.2 Inspection of Pipe Coatings

Any damage to the protective covering during transit and handling shall be repaired before installation. After field coating and wrapping has been applied, the entire pipe shall be inspected by an electric holiday detector with impressed current set at a value in accordance with NACE RP0274 using a full-ring, spring-type coil electrode. The holiday detector shall be equipped with a bell, buzzer, or other type of audible signal which sounds when a holiday is detected. All holidays in the protective covering shall be repaired immediately upon detection. The Contracting Officer reserves the right to inspect and determine the suitability of the detector. Labor, materials, and equipment necessary for conducting the inspection shall be furnished by the Contractor.

#### 3.5.2 Protective Covering for Aboveground Piping Systems

Finish painting shall conform to the applicable paragraphs of Section 09900 PAINTING, GENERAL and as follows:

##### 3.5.2.1 Ferrous Surfaces

Shop primed surfaces shall be touched up with ferrous metal primer same type paint as the shop primer. Surfaces that have not been shop primed shall be solvent-cleaned in accordance with SSPC SP 1. Surfaces that contain loose rust, loose mill scale, and other foreign substances shall be mechanically cleaned by power wire brushing in accordance with SSPC SP 3 or brush-off blast cleaned in accordance with SSPC SP 7 and primed with ferrous metal primer in accordance with SSPC Paint 25. Primed surfaces shall be finished with two coats of exterior alkyd paint conforming to SSPC Paint 104.

##### 3.5.2.2 Nonferrous Surfaces

Nonferrous surfaces shall not be painted.

#### 3.5.3 Protective Covering for Piping in Valve Boxes and Manholes

Piping in valve boxes or manholes shall receive protective coating as specified for underground steel pipe.

### 3.6 INSTALLATION

Gas distribution system and equipment shall be installed in conformance with the manufacturer's recommendations and applicable sections of ASME B31.8, AGA-01 and 49 CFR 192. Pipe shall be cut without damaging the pipe. Unless otherwise authorized, cutting shall be done by an approved type of mechanical cutter. Wheel cutters shall be used where practicable. Cutting of plastic pipe shall be in accordance with AGA-01. Valve installation in plastic pipe shall be designed to protect the plastic pipe against excessive torsional or shearing loads when the valve is operated and from other stresses which may be exerted through the valve or valve box.

#### 3.6.1 Installing Pipe Underground

Gas mains and service lines shall be graded as indicated and shall have 24 inch minimum cover. Both mains and service lines shall be placed on firmly compacted select material for the full length. Where indicated, the main shall be encased, or designed to withstand any anticipated external loads as specified in ASME B31.8. The encasement material shall be standard weight black steel pipe with a protective coating as specified. The pipe shall be separated from the casing by insulating spacers and sealed at the ends with casing bushings. Trench shall be excavated below pipe grade, bedded with bank sand, and compacted to provide full-length bearing. Laying the pipe on blocks to produce uniform grade will not be permitted. The pipe shall be clean inside before it is lowered into the trench and shall be kept free of water, soil, and all other foreign matter that might damage or obstruct the operation of the valves, regulators, meters, or other equipment. When work is not in progress, open ends of pipe or fittings shall be securely closed by expandable plugs or other suitable means. Minor changes in line or gradient of pipe that can be accomplished through the natural flexibility of the pipe material without producing permanent deformation and without overstressing joints may be made when approved. Changes in line or gradient that exceed the limitations specified shall be made with fittings. When polyethylene piping is installed underground, foil backed magnetic tape shall be placed above the pipe to permit locating with a magnetic detector. After laying of pipe and testing, trench shall be backfilled in accordance with Section C-02316 EXCAVATION, TRENCHING AND BACKFILLING FOR UTILITY SYSTEMS.

#### 3.6.2 Installing Pipe Aboveground

Aboveground piping shall be protected against dirt and other foreign matter as specified for underground piping. Joints in steel pipe shall be welded; however joints in pipe 1-1/2 inches in diameter and smaller may be threaded; joints may also be threaded to accommodate the installation of valves. Flanges shall be of the weld neck type to match wall thickness of pipe.

### 3.7 PIPE JOINTS

Pipe joints shall be designed and installed to effectively sustain the longitudinal pullout forces caused by the contraction of piping or superimposed loads.

#### 3.7.1 Threaded Steel Joints

Threaded joints in steel pipe shall have tapered threads evenly cut and shall be made with UL approved graphite joint sealing compound for gas service or polytetrafluoroethylene tape applied to the male threads only. Caulking of threaded joints to stop or prevent leaks will not be permitted.

### 3.7.2 Welded Steel Joints

Gas pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.8. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected adversely. Electrodes that have been wetted or have lost any of their coating shall not be used.

### 3.7.3 Polyethylene Pipe Jointing Procedures

Jointing procedures shall conform to AGA-01. Indiscriminate heat fusion joining of plastic pipe or fittings made from different polyethylene resins by classification or by manufacturer shall be avoided if other alternative joining procedures are available. If heat fusion joining of dissimilar polyethylenes is required, special procedures are required. The method of heat fusion joining dissimilar polyethylene resins shall be tested in accordance with paragraph TESTS, subparagraph Destructive Tests of Plastic Pipe Joints.

### 3.7.4 Connections Between Metallic and Plastic Piping

Connections shall be made only outside, underground, and with approved transition fittings.

## 3.8 VALVE BOXES

Valve boxes of cast iron not less than 3/16 inch thick shall be installed at each underground valve except where concrete or other type of housing is indicated. Valve boxes shall be provided with locking covers that require a special wrench for removal. Wrench shall be furnished for each box. The word "gas" shall be cast in the box cover. When the valve is located in a roadway, the valve box shall be protected by a suitable concrete slab at least 3 feet square. Boxes shall be adjustable extension type with screw or slide-type adjustments. Valve boxes shall be separately supported, not resting on the pipe, so that no traffic loads can be transmitted to the pipe. Valves shall only be located in valve boxes or inside of buildings.

## 3.9 DRIPS

Drips shall be installed at locations where required. Drips shall conform to the details shown or may be commercial units of approved type and capacity. A blow off pipe 1-1/4 inches or larger shall be connected to each drip at its lowest point and shall extend to or near the ground surface at a convenient location away from traffic. Discharge for each drip terminal (outlet) shall be provided with a reducing fitting, a plug valve, and a 1/2 inch nipple turned down. The discharge terminal (outlet) shall be inside a length of 12 inches or larger vitrified clay pipe, concrete sewer pipe or concrete terminal box set vertically on a bed of coarse gravel 1 foot thick and 3 feet square, and closed at the ground surface with a suitable replacement cover.

## 3.10 PRESSURE REGULATOR INSTALLATION

### 3.10.1 NOT USED

### 3.10.2 Service Line Regulators

A shutoff valve, meter set assembly, and service regulator shall be installed on the service line outside the building. An insulating joint shall be installed on the inlet side of the meter set assembly and service regulator and shall be constructed to prevent flow of electrical current. A 3/8 inch tapped fitting equipped with a plug shall be provided on both sides of the service regulator for installation of pressure gauges for adjusting the regulator. All service regulator vents and relief vents shall terminate in the outside air in rain and insect resistant fittings. The open end of the vent shall be located where gas can escape freely into the atmosphere, away from any openings into the building and above areas subject to flooding.

### 3.11 METER INSTALLATION

Meters shall be installed in accordance with ASME B31.8. Permanent gas meters shall be installed with provisions for isolation and removal for calibration and maintenance, and shall be suitable for operation in conjunction with an energy monitoring and control system.

### 3.12 CONNECTIONS TO EXISTING LINES

Connections between new work and existing gas lines, where required, shall be made in accordance with ASME B31.8 using proper fittings to suit the actual conditions. When connections are made by tapping into a gas main, the connecting fittings shall be the same size as the pipe being connected.

#### 3.12.1 NOT USED

#### 3.12.2 Connection to Government Owned/Operated Gas Lines

The Contractor shall provide connections to the existing gas lines in accordance with approved procedures. Deactivation of any portion of the existing system shall only be done at the valve location shown on the drawings. Reactivation of any existing gas lines will only be done by the Government. The Contractor's Connection and Abandonment Plan shall be submitted and approved prior to making any connections to existing gas lines. This plan shall include the Operating Agency's required procedures which may be obtained from Ft. Campbell DEH. The Contractor shall notify the Contracting Officer, in writing, 10 days before connections to existing lines are to be made.

#### 3.13 NOT USED

### 3.14 TESTS

#### 3.14.1 Destructive Tests of Plastic Pipe Joints

Each day, prior to making polyethylene heat fusion joints, a joint of each size and type to be installed that day shall be made by each person performing joining of plastic pipe that day and destructively tested. At least 3 longitudinal straps shall be cut from each joint. Each strap shall be visually examined, shall not contain voids or discontinuities on the cut surfaces of the joint area, and shall be deformed by bending, torque, or impact, and if failure occurs, it must not initiate in the joint area. If a joint fails the visual or deformation test, the qualified joiner who made that joint shall not make further field joints in plastic pipe on this job until that person has been retrained and requalified. The results of the destructive tests shall be recorded to include the date and time of the tests, size and type of the joints, ambient conditions, fusion iron temperature and names of inspectors and joiners.



### 3.14.2 Pressure and Leak Tests

The system of gas mains and service lines shall be tested after construction and before being placed in service using air as the test medium. The normal operating pressure for the system is 28 psi. The test pressure is 50 psi. Prior to testing the system, the interior shall be blown out, cleaned and cleared of all foreign materials. All meters, regulators, and controls shall be removed before blowing out and cleaning and reinstalled after clearing of all foreign materials. Testing of gas mains and service lines shall be done with due regard for the safety of employees and the public during the test. Persons not working on the test operations shall be kept out of the testing area while testing is proceeding. The test shall be made on the system as a whole or on sections that can be isolated. Joints in sections shall be tested prior to backfilling when trenches must be backfilled before the completion of other pipeline sections. The test shall continue for at least 24 hours from the time of the initial readings to the final readings of pressure and temperature. The initial test readings of the instrument shall not be made for at least 1 hour after the pipe has been subjected to the full test pressure, and neither the initial nor final readings shall be made at times of rapid changes in atmospheric conditions. The temperatures shall be representative of the actual trench conditions. There shall be no indication of reduction of pressure during the test after corrections have been made for changes in atmospheric conditions in conformity with the relationship  $T(1)P(2)=T(2)P(1)$ , in which T and P denote absolute temperature and pressure, respectively, and the numbers denote initial and final readings. During the test, the entire system shall be completely isolated from all compressors and other sources of air pressure. Each joint shall be tested by means of soap and water or an equivalent nonflammable solution prior to backfilling or concealing any work. The testing instruments shall be approved by the Contracting Officer. All labor, materials and equipment for conducting the tests shall be furnished by the Contractor and shall be subject to inspection at all times during the tests. The Contractor shall maintain safety precautions for air pressure testing at all times during the tests.

-- End of Section --

SECTION C-02710

SUBDRAINAGE SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO M 252 (1994) Corrugated Polyethylene  
Drainage Tubing

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 27/A 27M (1996) Steel Castings, Carbon, for  
General Application

ASTM A 47 (1990; R 1995) Ferritic Malleable Iron Castings

ASTM A 48 (1994a) Gray Iron Castings

ASTM C 14 (1995) Concrete Sewer, Storm Drain,  
and Culvert Pipe

ASTM C 55 (1996a) Concrete Building Brick

ASTM C 139 (1996a) Concrete Masonry Units for  
Construction of Catch Basins and Manholes

ASTM C 150 (1996) Portland Cement

ASTM C 231 (1997) Air Content of Freshly Mixed  
Concrete by the Pressure Method

ASTM D 1117 (1980) Methods of Testing Nonwoven Fabrics

ASTM D 4157 (1982) Test Method for Abrasion Resistance of  
Textile Fabrics (Oscillatory Cylinder Method)

ASTM D 5034 (1995) Breaking Force and Elongation of  
Textile Fabrics (Grab Test)

ASTM F 405 (1996) Corrugated Polyethylene (PE)  
Tubing and Fittings

FEDERAL SPECIFICATIONS (FS)

FS RR-F-621 (Rev E) Frames, Covers, Gratings, Steps,  
Sump and Catch Basin, Manhole

KENTUCKY DEPARTMENT OF HIGHWAYS (KDOH)

KDOH Standard Specifications for Road and Bridge  
Construction - 1998

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

#### SD-13 Certificates

Filter Sock; FIO. Filter Fabric; FIO. Pipe for Subdrains; FIO.

Certifications from the manufacturers attesting that materials meet specification requirements. Certificates are required for drain pipe, fittings, and filter fabric or filter sock.

#### SD-14 Samples

Filter Sock; FIO. Filter Fabric; FIO. Pipe for Subdrains; FIO.

Samples of filter sock or fabric, pipe, and pipe fittings, before starting the work.

### 1.3 DELIVERY, STORAGE, AND HANDLING

#### 1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with minimum handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. During shipment and storage, filter fabric shall be wrapped in burlap or similar heavy duty protective covering. The storage area shall protect the fabric from mud, soil, dust, and debris. Filter fabric materials that are not to be installed immediately shall not be stored in direct sunlight. Plastic pipe shall be installed within 6 months from the date of manufacture unless otherwise approved.

#### 1.3.2 Handling

Materials shall be handled in such a manner as to insure delivery to the trench in sound undamaged condition. Pipe shall be carried and not dragged to the trench.

#### 1.4 NOT USED

### PART 2 PRODUCTS

#### 2.1 PIPE FOR SUBDRAINS

Pipe for subdrains shall be of the types and sizes indicated.

##### 2.1.1 THRU 2.1.10 NOT USED

##### 2.1.11 Plastic Pipe

Plastic pipe shall contain ultraviolet inhibitor to provide protection from exposure to direct sunlight.

##### 2.1.11.1 NOT USED

##### 2.1.11.2 NOT USED

##### 2.1.11.3 Corrugated Polyethylene (PE) Pipe and Fittings

Use ASTM F 405 for pipes 3 to 6 inches in diameter, inclusive. Fittings shall be manufacturer's standard type and shall conform to the indicated specification.

#### 2.1.11.4 Pipe Perforations

Water inlet area shall be a minimum of 0.5 square inch per linear foot. Manufacturer's standard perforated pipe which essentially meets these requirements may be substituted with prior approval of the Contracting Officer.

a. Circular Perforations in Plastic Pipe: Circular holes shall be cleanly cut not more than 3/16 inch in diameter and arranged in rows parallel to the longitudinal axis of the pipe. Perforations shall be approximately 3 inches center-to-center along rows. The rows shall be approximately 1-1/2 inches apart and arranged in a staggered pattern so that all perforations lie at the midpoint between perforations in adjacent rows. The rows shall be spaced over not more than 155 degrees of circumference. The spigot or tongue end of the pipe shall not be perforated for a length equal to the depth of the socket, and perforations shall continue at uniform spacing over the entire length of the pipe.

b. Slotted Perforations in Plastic Pipe: Circumferential slots shall be cleanly cut so as not to restrict the inflow of water and uniformly spaced along the length and circumference of the tubing. Width of slots shall not exceed 1/8 inch nor be less than 1/32 inch. The length of individual slots shall not exceed 1-1/4 inches on 3 inch diameter tubing, 10 percent of the tubing inside nominal circumference on 4 to 8 inch diameter tubing. Rows of slots shall be symmetrically spaced so that they are fully contained in 2 quadrants of the pipe. Slots shall be centered in the valleys of the corrugations of profile wall pipe.

## 2.2 FILTER MATERIALS

### 2.2.1 Filter Fabric

Filter fabric shall be a pervious sheet of polyester, nylon, or polypropylene filaments woven or otherwise formed into a uniform pattern with distinct and measurable openings. The filter fabric shall provide an equivalent opening size (EOS) of 70+. EOS is defined as the number of the US Standard sieve having openings closest in size to the filter fabric openings. The filaments shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of propylene, ethylene, or vinylidene-chloride, and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistant to deterioration due to ultraviolet and heat exposure. The fabric shall have a minimum physical strength of 110 pounds per inch in any direction when tested in accordance with ASTM D 5034 using the grab test method with 1 square inch jaws and a constant rate of travel of 12 inches per minute. Elongation at failure shall be between 30 and 70 percent. The fabric shall be constructed so that the filaments will retain their relative position with respect to each other. The edges of the fabric shall be selvaged or otherwise finished to prevent the outer material from pulling away from the fabric.

### 2.2.2 Filter Sock

The perforated polyethylene pipe may be enclosed in a continuous filter sock, consisting of a polyester machine-knitted envelope which allows water entry while limiting the amount of sediment entering the pipe. The filter sock material shall be polyester with a specific gravity of 1.3 and weighing 3.5 ounces per square yard (ASTM D1910 and D3776). The filter material shall have a ball burst load of 100 lbs. (ASTM D3787) and a Mullen Burst strength of 135 psi (ASTM D3786). Water flow rate through the sock material by ASTM D737 shall be 700 GPM per square foot with a head of 3 inches. Equivalent opening size of the filter material shall be the U.S. Standard Sieve No. 40.

## 2.3 DRAINAGE STRUCTURES

### 2.3.1 NOT USED

### 2.3.2 Mortar

Mortar for connections to other drainage structures shall be composed of one part by volume of portland cement and two parts of sand. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar. Water shall be clean and free of injurious acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes from the time the ingredients are mixed with water.

### 2.3.3 HEADWALLS

Perforated pipe headwalls shall be as shown on the drawings and in accordance with the Kentucky Bureau of Highways Standard, included for reference immediately following this specification section.

#### 2.3.3.2 THRU 2.3.3.6 NOT USED

#### 2.3.3.7 NOT USED

#### 2.3.3.8 NOT USED

## 2.4 SUBDRAIN FILTER AND BEDDING MATERIAL

Subdrain filter and bedding material shall be washed sand, crushed stone, crushed stone screenings, or slag composed of hard, tough, durable particles free from

adherent coatings. Filter material shall not contain corrosive agents, organic matter, or soft, friable, thin, or elongated particles and shall have a gradation equivalent to KDOH No. 57.

### PART 3 EXECUTION

#### 3.1 EXCAVATION AND BEDDING FOR SUBDRAIN SYSTEMS

Trenching and excavation, including the removal of rock and unstable material, shall be in accordance with Section C-02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Bedding material shall be placed in the trench as indicated or as required as replacement materials used in those areas where unstable materials were removed. Compaction of the bedding material shall be as specified for cohesionless material in Section C-02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

#### 3.2 FLUSHING AND OBSERVATION RISERS (CLEANOUTS)

##### 3.2.1 NOT USED

##### 3.2.2 Flushing and Observation Risers

Flushing and observation riser pipes with frames and covers are labeled as "cleanout" on the plans and shall be installed at the locations indicated. Risers shall be constructed of precast concrete pipe. Joining of riser pipes to the subdrain system shall be as indicated.

#### 3.3 INSTALLATION OF FILTER FABRIC AND PIPE FOR SUBDRAINS

##### 3.3.1 Installation of Filter Fabric

##### 3.3.1.1 Trench Lining and Overlaps

Trenches to be lined with filter fabric as detailed in the typical cross sections shall be graded to obtain smooth side and bottom surfaces so that the fabric will not bridge cavities in the soil or be damaged by projecting rock. The fabric shall be laid flat but not stretched on the soil, and it shall be secured with anchor pins. Overlaps shall be at least 12 inches, and anchor pins shall be used along the overlaps.

3.3.1.2 At the Contractor's option, perforated pipe may be provided with a continuous filter sock material, in which case the filter fabric trench lining as shown on the plans shall be omitted.

##### 3.3.2 Installation of Pipe for Subdrains

##### 3.3.2.1 Pipelaying

Each pipe shall be carefully inspected before it is laid. Any defective or damaged pipe shall be rejected. No pipe shall be laid when the trench conditions or weather is unsuitable for such work. Water shall be removed from trenches by sump pumping or other approved methods. The pipe shall be laid to the grades and alignment as indicated. The pipe shall be bedded to the established gradeline. Perforations shall be centered on the bottom of the pipe. Pipes of either the bell-and-spigot type or the tongue-and-groove type shall be laid with the bell or groove ends upstream. All pipes in place shall be approved before backfilling. Polyester filter sock shall be stretched over pipe, continuous and undamaged, prior to installation.

##### 3.3.2.2 Jointings

Perforated Corrugated Polyethylene Pipe: Perforated corrugated polyethylene drainage pipe shall be installed in accordance with the manufacturer's specifications and as specified herein. A pipe with physical imperfections shall not be installed. No more than 5 percent stretch in a section will be permitted.

#### 3.3.2.3 Connections

Where pipe is to be connected to existing inlets, the connections shall be made in a workmanlike manner with masonry constructed around the connection so as to prevent leakage.

#### 3.4 NOT USED

#### 3.5 INSTALLATION OF FILTER MATERIAL AND BACKFILLING FOR SUBDRAINS

After pipe for subdrains has been laid, inspected, and approved, filter material shall be placed around and over the pipe to the depth indicated. The filter material shall be placed in layers not to exceed 8 inches thick, and each layer shall be thoroughly compacted by mechanical tampers or rammers to obtain the required density. Compaction of filter material and the placement and compaction of overlying backfill material shall be in accordance with the applicable provisions specified in Section C-02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

#### 3.6 TESTS

##### 3.6.1 Pipe Test

Strength tests of pipe shall conform to field service test requirements of the Federal Specification, ASTM specification, or AASHTO specification covering the product (paragraph PIPE FOR SUBDRAINS).

##### 3.6.2 NOT USED

-- End of Section --

SECTION C-02720

STORM-DRAINAGE SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 346/346R (1990) Standard Specification for Cast-in-Place Nonreinforced Concrete Pipe and Recommendations

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO-HB-16 (1996) Standard Specifications for Highway Bridges

AASHTO M 198 (1994) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 76 (1995) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

ASTM C 139 (1995) Concrete Masonry Units for Construction of Catch Basins and Manholes

ASTM C 231 (1991b) Air Content of Freshly Mixed Concrete by the Pressure Method

ASTM C 270 (1996a) Mortar for Unit Masonry

ASTM C 443 (1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets

ASTM C 478 (1994) Precast Reinforced Concrete Manhole Sections

ASTM C 655 (1994) Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe

ASTM D 1056 (1991) Flexible Cellular Materials - Sponge or Expanded Rubber

ASTM D 1557 (1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu.ft. (2,700 kN-m/cu.m.))

ASTM D 1751 (1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)



ASTM D 1752 (1984; R 1992) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM D 2167 (1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method

ASTM D 2922 (1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D 3017 (1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

KENTUCKY DEPARTMENT OF HIGHWAYS (KDOH)

KDOH Standard Specifications for Road and Bridge Construction - 1998

FEDERAL SPECIFICATIONS (FS)

FS HH-G-156 (Rev E) Gasket Material, General Purpose; Rubber Sheets, Strips, and Special Shapes

FS SS-S-210 (Rev A; Reinstatement Notice) Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints

FEDERAL TEST METHOD STANDARDS (FTM-STD)

FTM-STD 601 (Basic; Notices 1 thru 7) Rubber: Sampling and Testing

1.2 NOT USED

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-09 Reports

Field Density Tests; FIO.

Field density test results per PARAGRAPH 3.7.5.

SD-13 Certificates

Pipeline Testing; FIO. Hydrostatic Test on Watertight Joints; FIO.

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris.

Gasket materials and plastic materials shall be protected from exposure to the direct sunlight over extended periods.

#### 1.4.2 Handling

Materials shall be handled in such a manner as to insure delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

### PART 2 PRODUCTS

#### 2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

##### 2.1.1 Concrete Pipe

All concrete storm drain pipe shall be reinforced concrete pipe, ASTM C 76, Class III, unless otherwise noted.

##### 2.1.1.1 THRU 2.1.1.4 NOT USED

##### 2.1.2 NOT USED

##### 2.1.3 NOT USED

##### 2.1.4 NOT USED

##### 2.1.5 NOT USED

##### 2.1.6 NOT USED

##### 2.1.7 NOT USED

##### 2.1.8 NOT USED

##### 2.1.9 NOT USED

##### 2.1.10 NOT USED

#### 2.2 DRAINAGE STRUCTURES

##### 2.2.1 Flared End Sections

Sections shall be of a standard design precast reinforced concrete as shown on the drawings.

##### 2.2.2 NOT USED

#### 2.3 MISCELLANEOUS MATERIALS

##### 2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 3000 psi concrete under Section 03300 CONCRETE FOR BUILDING CONSTRUCTION. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Air content shall be determined in accordance with ASTM C 231. The concrete covering over steel reinforcing shall not be less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between

steel and ground. Expansion-joint filler material shall conform to ASTM D 1751, or ASTM D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

#### 2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but in no case shall exceed 7 gallons of water per sack of cement. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

#### 2.3.3 Precast Concrete Segmental Blocks

Precast concrete segmental block shall conform to ASTM C 139, not more than 8 inches thick, not less than 8 inches long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

#### 2.3.4 NOT USED

#### 2.3.5 Precast Reinforced Concrete Inlets

Precast reinforced concrete inlets shall conform to the Kentucky Department of Highways Standard Specifications for Road and Bridge Construction. Joints between precast concrete risers and tops shall be full-bedded in cement mortar and shall be smoothed to a uniform surface on both interior and exterior of the structure.

#### 2.3.6 Steps for Inlet Structures

Steps shall be provided in all inlets except KDOH Inlet Type II. Steps for inlets shall be spaced 12 to 16 inches apart and shall consist of No. 4 Grade 60 steel reinforcement encased in molded copolymer polypropylene plastic, PS1-PF, as manufactured by M.A. Industries, Inc., Kelley & Dividend Drive, Peachtree City, Georgia, 30269; or approved equal.

#### 2.3.7 Frame and Cover for Gratings

Frame and cover for gratings shall be cast gray iron, ASTM A 48, Class 35B or cast ductile iron, ASTM A 536, Grade 65-45-12 as shown. Weight, shape, size, and waterway openings for grates and resultant inlets shall be as indicated on the KDOH Standards.

#### 2.3.8 Joints

##### 2.3.8.1 Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.

b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Certified copies of test results shall be delivered to the Contracting Officer before

gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished if specifically approved.

#### 2.3.8.2 Plastic Sealing Compound

Requirements for preformed plastic sealing compound shall conform to FS SS-S-210.

#### 2.3.8.3 Flexible Watertight, Gasketed Joints

Gaskets: When infiltration or exfiltration is a concern for pipe lines, the couplings may be required to have gaskets. The closed-cell expanded rubber gaskets shall be a continuous band approximately 7 inches wide and approximately 3/8 inch thick, meeting the requirements of ASTM D 1056, Type 2 A1, and shall have a quality retention rating of not less than 70 percent when tested for weather resistance by ozone chamber exposure, Method B of ASTM D 1171. Rubber O-ring gaskets shall be 13/16 inch in diameter for pipe diameters of 36 inches or smaller and 7/8 inch in diameter for larger pipe having 1/2 inch deep end corrugation. Rubber O-ring gaskets shall be 1-3/8 inches in diameter for pipe having 1 inch deep end corrugations. O-rings shall meet the requirements of AASHTO M 198 or ASTM C 443. Flexible plastic gaskets shall conform to requirements of AASHTO M 198, Type B.

#### 2.3.8.4 NOT USED

#### 2.3.8.5 NOT USED

#### 2.3.8.6 NOT USED

#### 2.3.8.7 NOT USED

#### 2.3.8.8 NOT USED

#### 2.4 NOT USED

#### 2.5 NOT USED

#### 2.6 HYDROSTATIC TEST ON WATERTIGHT JOINTS

##### 2.6.1 Concrete Pipe

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced and nonreinforced concrete pipe shall conform to AASHTO M 198 or ASTM C 443.

##### 2.6.2 NOT USED

#### PART 3 EXECUTION

##### 3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches and for appurtenances and backfilling for culverts and storm drains shall be in accordance with the applicable portions of Section C-02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS and Section C-02225 EARTHWORK FOR ROADWAYS, RAILROADS, AND AIRFIELDS and the requirements specified below.

##### 3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 24 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing where required shall be placed within the trench width as specified. Care shall be taken not to overexcavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures shall be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

#### 3.1.2 Removal of Rock

Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 8 inches or 1/2 inch for each foot of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe. Rock excavation shall be as specified and defined in Section C-02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

#### 3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor in his performance of shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the government.

### 3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe. Bedding material shall be crush stone, KY #85 or #95, to a depth of 12-inches above and 6-inches below the pipe. When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded carefully in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe or to the lower curved portion of pipe arch for the entire length of the pipe or pipe arch. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be only of such length, depth, and width as required for properly making the particular type of joint. It is not required to shape the bedding to the pipe geometry.

#### 3.2.1 NOT USED

#### 3.2.2 NOT USED

#### 3.2.3 NOT USED

#### 3.2.4 NOT USED

#### 3.2.5 NOT USED

### 3.3 PLACING PIPE

Each pipe shall be carefully examined before being laid, and defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe be laid in water, and no pipe

shall be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. All pipe in place shall be inspected before backfilling, and those pipes damaged during placement shall be removed and replaced.

### 3.3.1 Concrete Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.3.2 NOT USED

3.3.3 NOT USED

3.3.4 NOT USED

3.3.5 NOT USED

3.3.6 NOT USED

3.3.7 NOT USED

3.3.8 NOT USED

### 3.4 JOINTS

#### 3.4.1 Concrete Pipe

3.4.1.1 THRU 3.4.1.5 NOT USED

#### 3.4.1.6 Plastic Sealing Compound Joints for Tongue-and-Grooved Pipe

Sealing compounds shall follow the recommendation of the particular manufacturer in regard to special installation requirements. Surfaces to receive lubricants, primers, or adhesives shall be dry and clean. Sealing compounds shall be affixed to the pipe not more than 3 hours prior to installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Sealing compounds shall be inspected before installation of the pipe, and any loose or improperly affixed sealing compound shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pulled together. If, while making the joint with mastic-type sealant, a slight protrusion of the material is not visible along the entire inner and outer circumference of the joint when the joint is pulled up, the pipe shall be removed and the joint remade. After the joint is made, all inner protrusions will be cut off flush with the inner surface of the pipe. If nonmastic-type sealant material is used, the "Squeeze-Out" requirement above shall be waived.

#### 3.4.1.7 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.4.1.8 NOT USED

3.4.2 NOT USED

### 3.5 DRAINAGE STRUCTURES

#### 3.5.1 Inlets

Construction shall be of reinforced concrete, plain concrete, or precast reinforced concrete, complete with frames and covers or gratings. Inlets shall be as shown on the drawings and in accordance with the Kentucky Bureau of Highway Standards included for reference immediately following this specification section.

3.5.2 NOT USED

3.6 NOT USED

### 3.7 BACKFILLING

#### 3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, backfill shall be as specified in Section C-02316 TRENCHING AND BACKFILLING FOR UTILITY SYSTEMS.

#### 3.7.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified in Section C-02316 TRENCHING AND BACKFILLING FOR UTILITY SYSTEMS.

#### 3.7.3 Movement of Construction Machinery

In compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

#### 3.7.4 Compaction

##### 3.7.4.1 General

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

##### 3.7.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density (densities) which will be determined as specified in this paragraph.

a. Under hardstands, paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas and gravelled areas, the density shall be not less than 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

b. Under turfed areas, density shall not be less than 85 percent of maximum density for cohesive material and 90 percent of maximum density for cohesionless material.

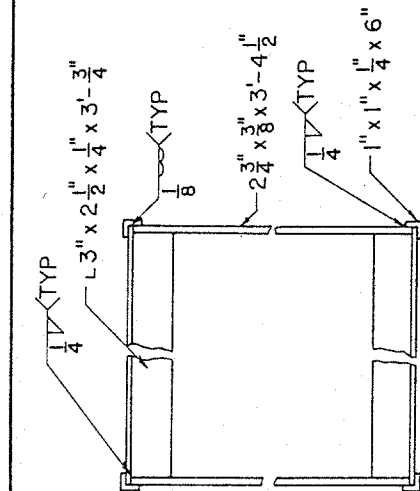
#### 3.7.5 Determination of Density

Testing shall be the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to insure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017 or ASTM D 2922. Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

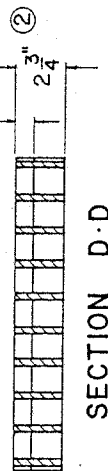
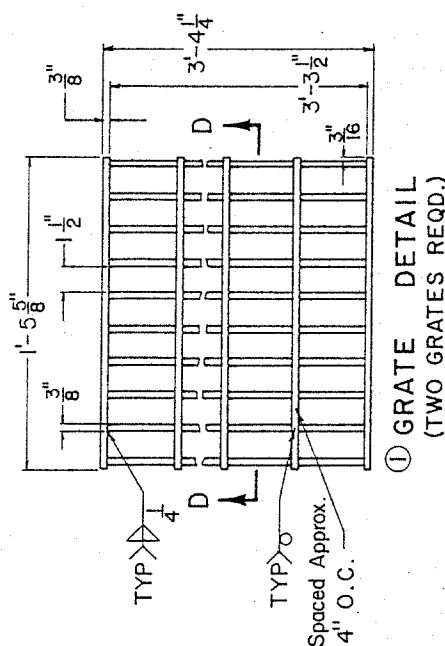
#### 3.8 NOT USED

-- End of Section --

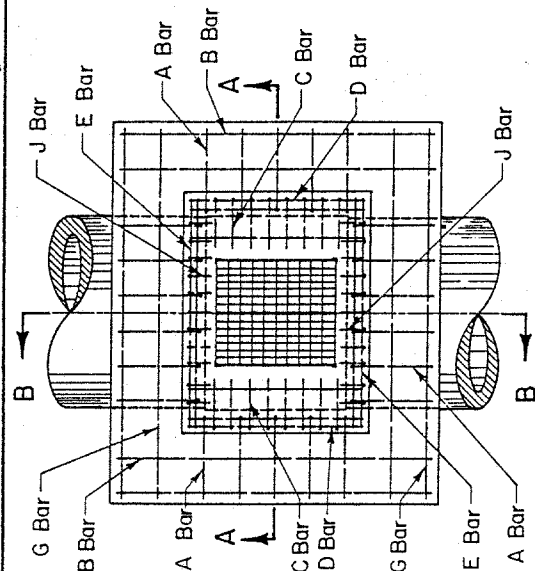




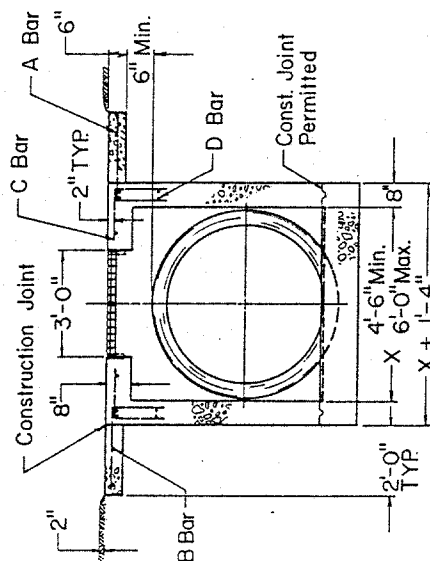
FRAME DETAIL



SECTION D-D



PLAN VIEW



SECTION A-A

SECTION B-B

..NOTES..

- ① Reliance Steel (Cat. No. H2 -12D) and Gary Steel (Cat. No. HW3-D-300) are acceptable alternates provided matched grates are supplied.
- ② The  $2\frac{3}{4}$ " bar shall be notched to receive the 1" cross bar.
3. Reinforcement shall have a clear distance of 2" from outside face unless otherwise shown.
4. This box is to be used primarily for sump conditions where a grated inlet is required for pipe sizes 42" thru 60".
5. See current Standard Drawing RDB-008 for Dimension and Steel Charts.

USE WITH CURRENT STANDARD  
DRAWING RDB-008

KENTUCKY BUREAU OF HIGHWAYS
DROP BOX INLET TYPE 7
(LAYOUT AND STEEL PATTERN)
STANDARD DRAWING No. RDB-007
SUBMITTED <i>R. E. Smith</i> 7/4/62
APPROVED <i>R. E. Smith</i> 7/4/62
DATE

METRIC CONVERSIONS  
1 FT. = 0.3048 m  
1 IN. = 25.4 mm

DIMENSIONS & ESTIMATE OF QUANTITIES

INLET NO.	SIZE		PIPE MAX. DIA.	PIPE SIDE	④ H	CONCRETE REINF.	
	X	Y				CUBIC YARDS	STEEL LBS.
1	3'-0"					4.3	0.4
2	4'-6"		42"	X	5'-1/2"	4.7	252
3				X or Y		5.0	348
4	4'-6"					5.3	365
5	3'-0"					4.9	255
6	3'-6"					5.2	268
7	5'-0"		48"	X	5'-7"	5.6	372
8	4'-6"					5.9	390
9	5'-0"			X or Y		6.3	416
10	3'-0"					5.4	262
11	3'-6"					5.8	276
12	5'-6"		54"	X	6'-1/2"	6.2	388
13	4'-6"					6.6	407
14	5'-0"					7.0	434
15	5'-6"			X or Y		7.4	453
16	3'-0"					6.0	278
17	3'-6"					6.4	292
18	4'-0"					6.8	412
19	6'-0"		60"	X	6'-8"	7.3	432
20	4'-6"					7.7	460
21	5'-0"					8.1	480
22	5'-6"			X or Y		8.5	508

REFERENCE CHART			CONCRETE TO DEDUCT FOR EACH PIPE	CUBIC YARDS
DIA. OF PIPE	DBI TYPE 7	PIPE ON "X" SIDE OF INLET		
0				
12"				
15"-18"				
21"-24"				
27"				
30"-33"				
36"				
42"				
48"				
54"				
60"				

NOTES

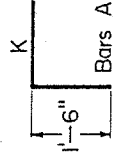
- Based on H as equal to D + t + t'-2".
- For pipe sizes less than 42" use applicable current RDB series.
- Q=Cubic Yards of concrete per foot increase or decrease when H varies from D + t + t'-2".
- No deductions have been made for pipe, see reference chart for quantities to deduct.

BILL OF REINFORCEMENT

Number 5 Reinforcement Bars													
M NO.	LGTH.	K	M NO.	LGTH.	K	M NO.	LGTH.	K	M NO.	LGTH.	K	M NO.	LGTH.
A	1	FT. IN.	A	1	FT. IN.	A	1	FT. IN.	A	1	FT. IN.	A	1
4'-6" x 3'-0"													
A 18	3	10	2	4	A 20	3	10	2	4	A 20	3	10	2
B 4	8	0			B 4	8	0			B 4	8	0	
C 12	2	5	0	11	C 14	2	8	1	2	C 14	2	8	1
D 10	4	0			D 10	4	0			D 10	4	0	
E 4	5	6			E 4	6	0			E 4	6	0	
G 4	9	6			G 4	10	0			G 4	10	0	
4'-6" x 3'-6"													
A 18	3	10	2	4	A 22	3	10	2	4	A 22	3	10	2
B 4	8	6			B 4	9	0			B 4	9	0	
C 14	2	5	0	11	C 16	2	8	1	2	C 16	2	8	1
D 10	4	6			D 10	5	0			D 10	5	0	
E 4	5	6			E 10	6	0			E 10	6	0	
G 4	9	6			G 4	10	0			G 4	10	0	
4'-6" x 4'-0"													
A 18	3	10	2	4	A 22	3	10	2	4	A 22	3	10	2
B 4	8	6			B 4	9	0			B 4	9	0	
C 14	2	5	0	11	C 16	2	8	1	2	C 16	2	8	1
D 10	4	6			D 10	5	0			D 10	5	0	
E 4	5	6			E 10	6	0			E 10	6	0	
G 4	9	6			G 4	10	0			G 4	10	0	
4'-6" x 4'-6"													
A 20	3	10	2	4	A 22	3	10	2	4	A 22	3	10	2
B 4	9	0			B 4	9	6			B 4	9	6	
C 16	2	5	0	11	C 18	2	8	1	2	C 18	2	8	1
D 10	5	0			D 10	5	6			D 10	5	6	
E 10	5	6			E 10	6	0			E 10	6	0	
G 4	9	6			G 4	10	0			G 4	10	0	
J 18	2	2	0	8	J 20	2	5	0	11	J 22	2	5	0
5'-0" x 4'-6"													
A 20	3	10	2	4	A 22	3	10	2	4	A 22	3	10	2
B 4	9	0			B 4	9	6			B 4	9	6	
C 16	2	5	0	11	C 18	2	8	1	2	C 18	2	8	1
D 10	5	0			D 10	5	6			D 10	5	6	
E 10	5	6			E 10	6	0			E 10	6	0	
G 4	9	6			G 4	10	0			G 4	10	0	
J 18	2	2	0	8	J 20	2	5	0	11	J 22	2	5	0
5'-0" x 5'-0"													
A 20	3	10	2	4	A 24	3	10	2	4	A 24	3	10	2
B 4	9	6			B 4	10	0			B 4	10	0	
C 18	2	5	0	11	C 20	2	8	1	2	C 20	2	8	1
D 10	5	6			D 10	6	0			D 10	6	0	
E 10	5	6			E 10	6	0			E 10	6	0	
G 4	9	6			G 4	10	0			G 4	10	0	
J 18	2	5	0	11	J 20	2	8	1	2	J 22	2	8	1
5'-0" x 3'-0"													
A 20	3	10	2	4	A 20	3	10	2	4	A 24	3	10	2
B 4	8	0			B 4	8	0			B 4	10	6	
C 12	2	8	1	2	C 12	2	11	1	5	C 22	2	11	1
D 10	4	0			D 10	4	0			D 10	6	6	
E 4	6	0			E 4	6	6			E 10	6	6	
G 4	10	0			G 4	10	6			G 4	10	6	
5'-6" x 3'-0"													
A 20	3	10	2	4	A 20	3	10	2	4	A 24	3	10	2
B 4	8	0			B 4	8	0			B 4	10	6	
C 12	2	8	1	2	C 12	2	11	1	5	C 22	2	11	1
D 10	4	0			D 10	4	0			D 10	6	6	
E 4	6	0			E 4	6	6			E 10	6	6	
G 4	10	0			G 4	10	6			G 4	10	6	

- BAR NOTES
- Number of Bars in one DBI. TYPE 7.
  - Dimensions are O. to O. of Bars.
  - All Bars are straight except those shown below.

BENT BAR SHAPE



USE WITH CURRENT STANDARD DRAWING RDB-007

KENTUCKY BUREAU OF HIGHWAYS

DROP BOX INLET

TYPE 7

(DIMENSION AND STEEL CHARTS)

STANDARD DRAWING No. RDB-008

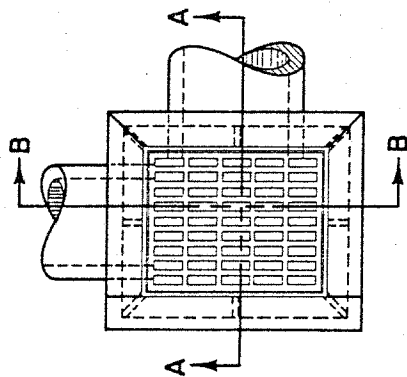
SUBMITTED 1/14/11  
APPROVED 1/14/11  
DATE 1/14/11

8. "t" is concrete pipe wall thickness or metal pipe corrugation depth.

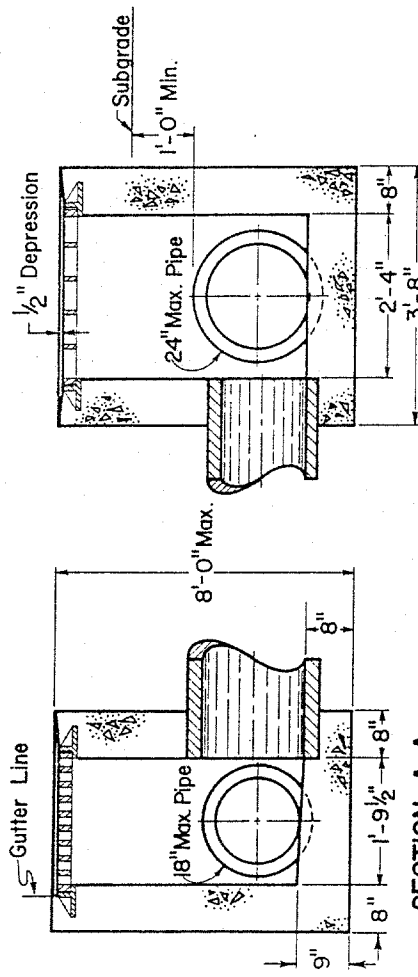
9. D=Inside Diameter of Pipe.

10. A, B and C Bars spaced 12" O.C., C and J Bars spaced 6" O.C., all other bars spaced as shown.

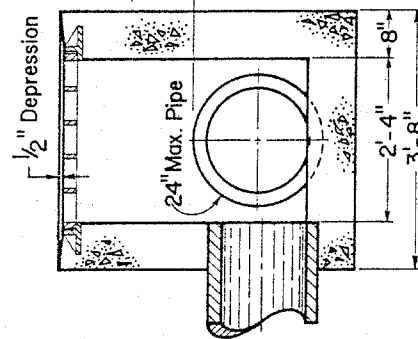
METRIC CONVERSIONS  
1 FT. = 0.3048 m  
1 IN. = 25.4 mm



PLAN VIEW



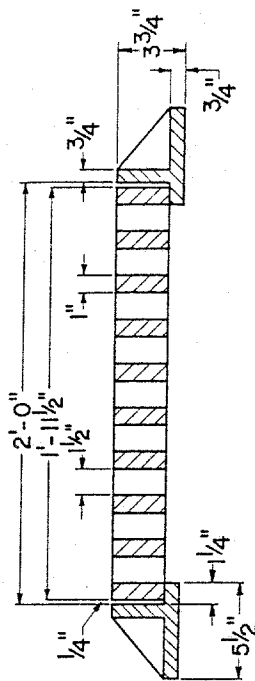
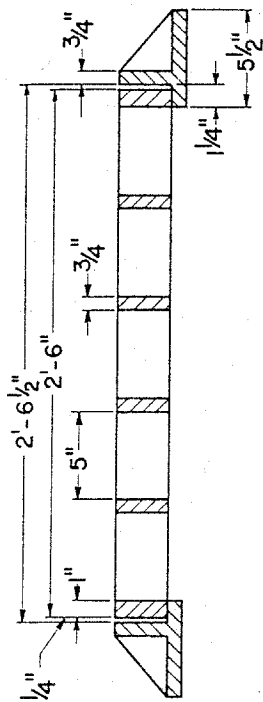
SECTION A-A



SECTION B-B

APPROXIMATE QUANTITIES		
PIPE SIZE	MIN. HEIGHT	CU. YDS. CONC.
15"	2'-11"	0.89
18"	3'-3"	0.97
24"	4'-9"	1.38
WEIGHT OF GRATE = 265 Lbs.		
WEIGHT OF FRAME = 195 Lbs.		

No deductions have been made for pipe.



SECTIONAL VIEW OF FRAME & GRATE

METRIC CONVERSIONS  
1 FT. = 0.3048 m  
1 IN. = 25.4 mm

KENTUCKY  
BUREAU OF HIGHWAYS

DROP BOX  
INLET TYPE II

STANDARD DRAWING No. RDB OII-05  
SUBMITTED BY *Robert B. Smith* DATE *2/14/11*  
APPROVED BY *James H. Smith* DATE *2/14/11*

## SECTION C-02730

### SANITARY SEWERS

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM C 33	(1993) Concrete Aggregates
ASTM C 94	(1995) Ready-Mixed Concrete
ASTM C 150	(1995) Portland Cement
ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM C 270	(1995a) Mortar for Unit Masonry
ASTM C 478	(1994) Precast Reinforced Concrete Manhole Sections
ASTM C 828	(1990) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C 924	(1989) Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM D 412	(1992) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 624	(1991) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 1784	(1992) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2680	(1995) Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	(1993) Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 3034	(1994) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1992) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

ASTM F 402 (1993) Safe Handling of Solvent  
Cements, Primers, and Cleaners Used for  
Joining Thermoplastic Pipe and Fittings

FEDERAL SPECIFICATIONS (FS)

FS RR-F-621 (Rev E) Frames, Covers, Gratings,  
Steps, Sump and Catch Basin, Manhole

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 49 (1994) Hazardous Chemicals Data

NFPA 325M (1991) Fire Hazard Properties of  
Flammable Liquids, Gases, and Volatile  
Solids

NFPA 704 (1990) Identification of the Fire  
Hazards of Materials

1.2 GENERAL REQUIREMENTS

The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 5 feet outside the building to which the sewer system is to be connected. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to the Government. Excavation and backfilling is specified in Section C-02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Backfilling shall be accomplished after inspection by the Contracting Officer. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3 NOT USED

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-01 Data

Pipe and Related Materials; GA.

Submit manufacturer's data on proposed materials for sanitary sewer pipe and appurtenances.

SD-09 Reports

Test Results; FIO.

Submit written reports documenting satisfactory results of air exfiltration tests and plastic sewer pipe deflection tests.

## PART 2 PRODUCTS

### 2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

#### 2.1.1 NOT USED

#### 2.1.2 Plastic Pipe

##### 2.1.2.1 ABS Pipe

ASTM D 2751.

##### 2.1.2.2 PVC Pipe

ASTM D 3034, Type PSM with a maximum SDR of 35, Size 15 inches or less in diameter. PVC shall be certified by the compounder as meeting the requirements of ASTM D 1784, cell Class 12454B. The pipe stiffness shall be greater than or equal to 735/D for cohesionless material pipe trench backfills.

##### 2.1.2.3 NOT USED

#### 2.1.3 THRU 2.1.7 NOT USED

### 2.2 FITTINGS

Fittings shall be compatible with the pipe supplied and shall have a strength not less than that of the pipe.

#### 2.2.1 THRU 2.2.7 NOT USED

### 2.3 JOINTS

Joints installation shall comply with the manufacturer's instructions.

#### 2.3.1 NOT USED

#### 2.3.2 Plastic Pipe

Flexible plastic pipe (PVC) gasketed joints shall conform to ASTM D 3212.

##### 2.3.2.1 ABS Pipe

ASTM D 2751, solvent weld or bell and spigot O-ring joint, size 12 inches or less in diameter, dimensions and tolerances in accordance with Table 2 therein.

##### 2.3.2.2 NOT USED

#### 2.3.3 THRU 2.3.7 NOT USED

### 2.4 NOT USED

### 2.5 FRAMES AND COVERS

Frames and covers shall be cast iron or ductile iron. Cast iron frames and covers shall be as indicated or shall conform to FS RR-F-621, type as suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 400 pounds. The word "Sewer" shall be stamped or cast into covers so that it is plainly visible.

## 2.6 MANHOLE STEPS

Steps shall be provided in all manholes. Steps for manholes shall be spaced 12 inches apart and shall consist of No. 4 Grade 60 steel reinforcement encased in molded copolymer polypropylene plastic, PS1-PF, as manufactured by M.A. Industries, Inc.; Kelly & Dividend Drive, Peachtree City, Georgia, 30269; or approved equal.

## 2.7 CEMENT MORTAR

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

### 2.7.1 Portland Cement

Portland cement shall conform to ASTM C 150, Type II for concrete used in concrete pipe, concrete pipe fittings, and manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking.

### 2.7.2 Portland Cement Concrete

Portland cement concrete shall conform to ASTM C 94, compressive strength of 4000 psi at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement shall have a compressive strength of 2500 psi minimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

## 2.8 STRUCTURES

### 2.8.1 Precast Reinforced Concrete Manhole Sections

Precast reinforced concrete manhole sections shall conform to ASTM C 478, except that portland cement shall be as specified herein. Joints shall be cement mortar, or an approved mastic or rubber gasket, or an approved combination of these types.

### 2.8.2 NOT USED

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Adjacent Facilities

##### 3.1.1.1 Water Lines

Where the location of the sewer is not clearly defined by dimensions on the drawings, the sewer shall not be closer horizontally than 10 feet to a water-supply main or service line, except that where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, the horizontal spacing may be a minimum of 6 feet. Where gravity-flow sewers cross above water lines, the sewer pipe for a distance of 10 feet on each side of the crossing shall be fully encased in concrete or shall be acceptable pressure pipe with no joint closer horizontally than 3 feet to the crossing. The thickness of the concrete encasement including that at the pipe joints shall be not less than 4 inches.

##### 3.1.1.2 NOT USED

##### 3.1.1.3 NOT USED

#### 3.1.2 Pipe Laying

a. Pipe shall be protected during handling against impact shocks and free fall and the pipe interior shall be free of extraneous material.

b. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid accurately to the line and grade shown on the drawings. Pipe shall be laid and centered so that the sewer has a uniform invert. As the work progresses, the interior of the sewer shall be cleared of all superfluous materials.

c. Before making pipe joints all surfaces of the portions of the pipe to be joined shall be clean and dry. Lubricants, primers, and adhesives shall be used as recommended by the pipe manufacturer. The joints shall then be placed, fitted, joined, and adjusted to obtain the degree of water tightness required.

d. Installations of solvent weld joint pipe, using ABS or PVC pipe and fittings shall be in accordance with ASTM F 402. All required precautions shall be taken to assure adequate trench ventilation and protection for workers installing the pipe.

#### 3.1.2.1 NOT USED

#### 3.1.2.2 Trenches

Trenches shall be kept free of water and as dry as possible during bedding, laying, and jointing and for as long a period as required. When work is not in progress, open ends of pipe and fittings shall be satisfactorily closed so that no trench water or other material will enter the pipe or fittings.

#### 3.1.2.3 Backfill

As soon as possible after the joint is made, sufficient backfill material shall be placed along the pipe to prevent pipe movement off line or grade. Plastic pipe shall be completely covered to prevent damage from ultraviolet light.

#### 3.1.2.4 Width of Trench

If the maximum width of the trench at the top of the pipe, as specified in Section C-02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, is exceeded for any reason other than by direction, the Contractor shall install at no additional cost to the Government such concrete cradling, pipe encasement, or other bedding required to support the added load of the backfill.

#### 3.1.2.5 Joints

Joints between different pipe materials shall be made as specified, using approved jointing materials.

#### 3.1.2.6 Handling and Storage

Pipe, fittings and joint material shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities for plastic pipe, fittings, joint materials and solvents shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325M.

#### 3.1.3 Leakage Tests

Lines shall be tested for leakage by low pressure air testing. Low pressure air testing procedures shall use the pressures and testing times prescribed in ASTM C 828 and ASTM C 924, after consultation with the pipe manufacturer. Manholes shall be vacuum tested for leakage. When leakage exceeds the maximum amount



specified, satisfactory correction shall be made and retesting accomplished. Testing, correction, and retesting shall be made at no additional cost to the Government.

#### 3.1.4 Test for Deflection

When flexible pipe is used, a deflection test shall be made on the entire length of the installed pipeline not less than 30 days after the completion of all work including the leakage test, backfill, and placement of any fill, grading, paving, concrete, or superimposed loads. Deflection shall be determined by use of a deflection device or by use of a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. The ball, cylinder, or circular sections shall have a diameter, or minor diameter as applicable, of 95 percent of the inside diameter of the pipe. A tolerance of plus 0.5 percent will be permitted. The ball, cylinder, or circular sections shall be of a homogeneous material throughout, shall have a density greater than 1.0 as related to water at 39.2 degrees F, and shall have a surface brinell hardness of not less than 150. It shall be center bored and through bolted with a 1/4 inch minimum diameter steel shaft having a yield strength of 70,000 psi or more, with eyes at each end for attaching pulling cables. The eye shall be suitably backed with flange or heavy washer such that a pull exerted on the opposite end of the shaft shall produce compression throughout the remote end of the ball, cylinder or circular section. Circular sections shall be so spaced that the distance from the external faces of the front and back sections shall equal or exceed the diameter of the circular section. Failure of the ball, cylinder, or circular section to pass freely through a pipe run, either by being pulled through or by being flushed through with water, shall be cause for rejection of that run. When a deflection device is used for the test in lieu of the ball, cylinder, or circular sections described, such device shall be approved prior to use. The device shall be sensitive to 1.0 percent of the diameter of the pipe being measured and shall be accurate to 1.0 percent of the indicated dimension. Installed pipe showing deflections greater than 5 percent of the normal diameter of the pipe, shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced at no cost to the Government.

#### 3.2 CONCRETE CRADLE AND ENCASEMENT

The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

#### 3.3 NOT USED

#### 3.4 MANHOLES

#### 3.4.1 General

Manholes shall be constructed of precast concrete manhole sections. The invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels shall be formed directly in the concrete of the manhole base, or shall be built up with brick and mortar, or shall be half tile laid in concrete, or shall be constructed by laying full section sewer pipe through the manhole and breaking out the top half after the surrounding concrete has hardened. Pipe connections shall be made to manhole using water stops, standard O-ring joints, special manhole coupling, or shall be made in accordance with the manufacturer's recommendation. The Contractor's proposed method of connection, list of materials selected, and specials required, shall be approved prior to installation. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 1 inch per foot nor more than 2 inches per foot.

#### 3.4.2 NOT USED

#### 3.4.3 Jointing, Plastering and Sealing

Mortar joints shall be completely filled and shall be smooth and free from surplus mortar on the inside of the manhole. Mortar and mastic joints between precast rings shall be full-bedded in jointing compound and shall be smoothed to a uniform surface on both the interior and exterior of the manhole. Installation of rubber gasket joints between precast rings shall be in accordance with the recommendations of the manufacturer. Precast rings may also be sealed by the use of extruded rolls of rubber with mastic adhesive on one side.

#### 3.4.4 Frames and Covers

Unless otherwise indicated, tops of frames and covers shall be set flush with finished grade in paved areas or 2 inches higher than finished grade in unpaved areas. Frame and cover assemblies shall be sealed to manhole sections using external preformed rubber joint seals that meet the requirements of ASTM D 412 and ASTM D 624, or other methods specified in paragraph Jointing, Plastering and Sealing, unless otherwise specified.

#### 3.4.5 NOT USED

### 3.5 CONNECTIONS TO EXISTING MANHOLES

Pipe connections to existing manholes shall be made in such manner that the finish work will conform as nearly as practicable to the essential applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1-1/2 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

### 3.6 BUILDING CONNECTIONS

Building connections shall include the lines to and connection with the building waste drainage piping at a point approximately 5 feet outside the building, unless otherwise indicated. Where building drain piping is not installed, the Contractor shall terminate the building connections approximately 5 feet from the site of the building at a point and in a manner designated.

### 3.7 CLEANOUTS AND OTHER APPURTENANCES

Cleanouts and other appurtenances shall be installed where shown on the drawings or as directed by the Contracting Officer, and shall conform to the detail of the drawings.

-- End of Section --

## SECTION C-02754

### CONCRETE PAVEMENT FOR HARDSTANDS

#### PART 1 - GENERAL

1. APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### ACI INTERNATIONAL (ACI)

ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 301	(1996) Standard Specification for Structural Concrete
ACI 305R	(1991) Hot Weather Concreting

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 184	(1990) Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 615	(1996) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 31	(1996) Making and Curing Concrete Test Specimens in theField
ASTM C 33	(1993) Concrete Aggregates
ASTM C 39	(1996) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 94	(1996) Ready-Mixed Concrete
ASTM C 123	(1994) Lightweight Pieces in Aggregate
ASTM C 143	(1990a) Slump of Hydraulic Cement Concrete
ASTM C 150	(1996) Portland Cement
ASTM C 192	(1990a) Making and Curing Concrete Test Specimens in theLaboratory
ASTM C 231	(1991b) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 595	(1995a) Blended Hydraulic Cements

ASTM C 618	(1996a) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 666	(1992) Resistance of Concrete to Rapid Freezing and Thawing
ASTM C 881	(1990) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 989	(1994a) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1077	(1995a) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1992) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

ARMY CORPS OF ENGINEERS (COE)

COE CRD-C 130	(1989) Scratch Hardness of Coarse Aggregate Particles
COE CRD-C 300	(1990) Specifications for Membrane-Forming Compounds for Curing Concrete
COE CRD-C 540	(1971; R 1981) Standard Specification for Nonbituminous Inserts for Contraction Joints in Portland Cement Concrete Airfield Pavements, Sawable Type
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstop

NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100	(1990) Concrete Plant Standards
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1.2 NOT USED

1.3 NOT USED

1.4 NOT USED

1.5 NOT USED

1.6 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01399 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Aggregate Sources; GA.

Data as required in PARAGRAPH 2.1.1.

Batch Plant; Mixers; FIO.

Details and data on the concrete batch plant, including manufacturer's literature on the cementitious material and aggregate feed equipment, water controls, and pug mill mixers, showing that the equipment meets all requirements specified herein.

Construction Methods; FIO.

Submit data describing contractor's proposed methods and equipment as specified in PARAGRAPH 4.2.

Concrete Mix Design; GA.

Submit contractor's mix design. See PARAGRAPH 9.1

Contraction Joint Inserts; FIO.

Data on all inserts shall be submitted as stated in PARAGRAPH 16.5.2.

#### SD-07 Schedules

Paving Operations; GA.

Schedule of paving operations, at least 7 days prior to start of paving unless otherwise specified.

#### SD-13 Certificates

Materials; FIO.

Submit manufacturer's certificates as required by PARAGRAPH 2.1.3 for concrete constituents, admixtures, and related materials.

Aggregate Quality; FIO.

Provide certificates of aggregate quality as specified in PARAGRAPH 22.1.

#### SD-09 Reports

Field Test Results; FIO.

Submit test results at regular intervals, as specified in PARAGRAPH 22.4.

## 2. MATERIAL ACCEPTANCE TESTING:

### 2.1 Preconstruction Sampling and Testing:

2.1.1 Aggregates: Aggregates shall be produced from the sources listed in SPECIAL CLAUSES. Aggregate sources shall be submitted in writing to the Government 60 days prior to concrete paving operation.

#### 2.1.2 NOT USED

2.1.3 Sixty (60) days prior to start of concrete paving operations, the Contractor shall submit, in accordance with SECTION: C-01305, SUBMITTAL PROCEDURES, manufacturer's certificates for the cement, pozzolan, admixtures, curing compound and epoxy resin material showing compliance with requirements of this project.

### 2.2 Acceptance Sampling and Testing During Construction:

2.2.1 Aggregates: During construction, aggregates may be sampled for acceptance testing before delivery to the mixer to determine compliance with specification provisions. The Contractor shall provide facilities and labor as may be necessary for the ready procurement of representative samples. Samples as delivered to the mixer shall be obtained when directed by the Contracting Officer and under his supervision. The Government will test such samples at its expense. Quality assurance tests of aggregates at various stages in the process and handling operations will be made at the discretion of the Contracting Officer.

2.2.2 Prequalified Cement Sources: Cement shall be delivered and used directly from a mill of a producer designated as a qualified source. Samples of cement for check testing may be taken at the project site or the concrete producing plant by a representative of the Contracting Officer for testing at the expense of the Government. A list of prequalified cement sources is available from the Commander and Director, U. S. Army Engineer Waterways Experiment Station (ATTN: WESSC), P. O. Box 631, Vicksburg, Mississippi 39180.

2.2.2.1 Other Cement Sources: The sampling, testing, and shipping inspection from the point of sampling when the point of sampling is other than at the site of the work will be made by, or under the supervision of, the Government and at its expense. Cement meeting all other requirements may be accepted before the required 7-day age when the strength is equal to or greater than the 7-day requirement. In the event of failure, the cement may be resampled and tested at the request of the Contractor and at the Contractor's expense. When the point of sampling is other than at the site of the work, the fill gate or gates of the sampled bin will be sealed and kept sealed until shipment from the bin has been completed. Sealing of the fill gate or gates and of conveyances used in shipment will be done by or under the supervision of the Government. Conveyances will not be accepted at the site of the work unless received with all seals intact. If tested cement is rehandled at transfer points, the extra cost of inspection will be at the Contractor's expense.

2.2.3 NOT USED

2.2.4 NOT USED

2.2.5 NOT USED

2.2.6 NOT USED

2.3 Construction Testing by Government: The Government may sample and test aggregates and concrete to determine compliance with the specifications. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching. Concrete will be sampled in accordance with ASTM C 172. Slump and air content will be determined in accordance with ASTM C 143 and ASTM C 231, respectively. Test specimens for strength determinations will be cured as described in ASTM C 31, and flexural strength determinations will be made by the third-point loading method presented in ASTM C 78.

### 3. EVALUATION AND ACCEPTANCE:

3.1 NOT USED

3.2 Requirements for Vehicular Pavements Other than Roads and Streets: Parking-area, motor-pool and motor-storage-area, repair-yard and open-storage-area pavements shall be smooth and true to grade and cross section. When tested with a 10-foot straightedge on lines 5 feet apart parallel with, and at right angles to, the center line of the paved area, the surface shall vary not more than 1/4-inch from the testing edge of the straightedge.

3.3 Surface Tests and Corrections: As soon as the concrete has hardened enough to permit walking thereon, but not later than 24 hours after the concrete has been placed, the surface of the pavement shall be tested with an approved straightedge or other approved device that will reveal all surface irregularities varying from the testing edge exceeding tolerances specified above for open-storage concrete pavements. The testing shall be performed by the Contractor at no expense to the Government. High spots indicated by the testing edge in excess of applicable tolerances shall be marked plainly and removed or reduced by rubbing with a carborundum brick and water. Rubbing shall be discontinued as soon as contact with the coarse aggregate is made. If high spots cannot be removed in the above manner because of disturbing the coarse aggregate, the high portion of the pavement shall be corrected by an approved surface-grinding machine after the concrete is 14 days old, or the pavement shall be removed and replaced. No area of pavement that was removed and replaced and no adjacent slab or portion of a slab that remains in the pavement abutting the replacement slab shall have a length or width less than 10 feet. Testing for acceptance or rejection of the finished pavement surface will be performed by the Government at no expense to the Contractor.

3.4 Thickness Tolerances: Pavements shall be of the thicknesses indicated on the plans. Deficiencies in the thickness shall be treated as described below. Permissible deficiency in pavement thickness will be up to but not including 1/2-inch of the specified thickness.

3.5 Thickness Evaluation: The thickness of the pavement shall be determined by the Contractor, under the direction of the Government and at no additional cost to the Government, on the basis of measurements made on cores drilled from points in the pavement with a minimum of one test per 500 linear feet of paving and selected in a random fashion within 7 days after placement of the concrete. Measurements of individual cores shall be performed in accordance with ASTM C 174. Refilling of core holes shall be performed by the Contractor at no cost to the Government.

3.6 Thickness Deficiency: When the measurement of any core indicates that the pavement is deficient in thickness 1/2-inch or more, additional cores will be drilled along the center line of the lane at 25-foot intervals on each side of the deficient core, until the cores indicate that the deficiency in thickness is less than 1/2-inch. When any core shows a deficiency in thickness of 1/2-inch or more, the area represented by that core shall be removed and replaced with pavement of the indicated thickness in conformance with requirements of paragraph REMOVAL AND REPLACEMENT OF DEFECTIVE CONCRETE. The area represented by the core shall be the full paving lane width midway between adjacent cores or the regularly scheduled transverse joint should such a joint fall between the cores. When surface grinding and texture restoration are required that result in thickness deficiencies which exceed the permissible deviations, the concrete removal and replacement requirements will apply as specified in paragraph REMOVAL AND REPLACEMENT OF DEFECTIVE CONCRETE.

#### 4. APPROVAL OF PLANT, EQUIPMENT, AND CONSTRUCTION METHODS:

4.1 Plant and Equipment: The Contracting Officer shall be given access at all times to all parts of the plant and equipment for checking adequacy of the equipment in use; operation of the plant, verifying weights, proportions, temperature, mixing time, and character of the materials.

4.1.1 Batch Plant: Details and data on the concrete plant shall be submitted for review.

4.1.2 Mixers: The make, type, capacity, and number of the concrete mixers proposed for use shall be submitted for review.

#### 4.2 Construction Methods:



4.2.1 Hauling Equipment: A description of the equipment proposed for transporting concrete from the central mixing plant to the placing equipment shall be submitted for review.

4.2.2 Placing Equipment: A description of the equipment proposed for placing concrete and the method of placing shall be submitted for review.

4.2.3 Finishing Equipment: A description of the equipment proposed for surface texturing and the method of surface texturing shall be submitted for review.

4.2.4 Curing: The curing media and methods to be used shall be submitted in writing for review. The Contractor shall notify the Contracting Officer of the source from which the curing compound is to be obtained at least 30 days in advance of the time concrete placing is expected to begin. A manufacturer's certificate shall be furnished by the Contractor certifying that the impervious sheet curing materials, if used, comply with the requirements of ASTM C 171.

4.2.5 Cold Weather Requirements: When concrete is to be placed under or exposed to cold weather conditions, a description of the materials and methods proposed for protection of the concrete shall be furnished to the Contracting Officer for review.

4.2.6 Hot Weather Requirements: When concrete is to be placed under or exposed to hot weather conditions, a description of the methods proposed for cooling aggregate and water and the methods used to prevent evaporation in excess of 0.2 psf per hour from the placed concrete shall be submitted to the Contracting Officer for review.

## 5. MATERIAL DELIVERY, STORAGE, AND HANDLING:

### 5.1 Cementitious Materials:

5.1.1 Transportation: When bulk cement or pozzolan is not unloaded from primary carriers directly into weathertight hoppers at the batching plant, transportation from the railhead, mill, or intermediate storage to the batching plant shall be accomplished in adequately designed weathertight trucks, conveyors, or other means that will protect the cement or pozzolan completely from exposure to moisture.

5.1.2 Storage: Immediately upon receipt at the site of the work, cementitious materials shall be stored in a dry, weathertight, and properly ventilated structure. All storage facilities shall be subject to approval and shall be such as to permit easy access for inspection and identification. Sufficient cementitious materials shall be in storage to sustain continuous operation of the concrete mixing plant while pavement is being placed. To prevent cement from becoming unduly aged after delivery, the Contractor shall use any cement that has been stored at the site for 60 days or more before using cement of lesser age.

5.1.3 Separation of Materials: Separate facilities shall be provided for unloading, transporting, storage, and handling each type of cementitious material.

### 5.2 Aggregates:

5.2.1 Storage: Aggregate shall be stored at the site of the batching plant in a manner to avoid breakage, segregation, or contamination by foreign materials. Each size of aggregate from each source shall be stored separately in free-draining stockpiles. Fine aggregate and the smaller size of coarse aggregate shall remain in free-draining storage for at least 24 hours immediately prior to use. Sufficient aggregate shall be maintained at the site at all times

to permit continuous uninterrupted operation of the mixing plant while concrete is being placed.

5.2.2 Handling: Aggregate shall be handled in a manner to prevent segregation. Vehicles used for stockpiling or moving aggregate shall be kept clean of foreign materials. Stockpiles shall be worked in a manner to prevent different sizes of aggregate from being mixed during storage or loading of batching hoppers.

6. NOT USED

7. NOT USED

## PART 2 - PRODUCTS

### 8. MATERIALS:

#### 8.1 Cement:

8.1.1 General: Cement and pozzolan may be furnished in bulk or packages. When cement is furnished in packages, mixing batch proportions shall be adjusted to require complete packages of cement.

8.1.2 Portland Cement: Portland cement shall conform to ASTM C 150, Class I or II, low alkali, including the false set requirement.

8.1.3 High Early-Strength Portland Cement: High early-strength portland cement shall conform to ASTM C 150, Type III, low alkali, with tricalcium aluminate limited to 5 percent, and shall be used only when specifically approved in writing. Concrete made with such cement shall be subject to all applicable provisions of these specifications.

8.1.4 NOT USED

8.1.5 NOT USED

8.1.6 Portland-Pozzolan Cement: Portland-pozzolan cement shall conform to the requirements of ASTM C 595, Type IP, low alkali.

8.1.7 Pozzolan: Pozzolan shall conform to ASTM C 618, Class F, low alkali, except that the values below shall be used in lieu of those provided in Tables 1 and 2 of ASTM C 618.

Table 1

	Mineral Admixture Class <u>F</u>
Loss on ignition, maximum, percent	6.0

Table 2

	Mineral Admixture Class <u>F</u>
Pozzolanic activity index with lime, at 7 days min, psi	900

\*ASTM C 618 value unchanged

8.1.8 Temperature: The temperature of the cement and pozzolan as delivered to storage at the site, shall not exceed 150 degrees F.

#### 8.2 Admixtures:

8.2.1 Air-Entraining Admixtures: The air-entraining admixture shall conform to ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entraining admixture shall be in a solution of suitable viscosity for field use.

8.2.2 Accelerator: The use of an accelerator in concrete shall in no way relieve the Contractor of responsibility for compliance with the requirements of these specifications governing protection and curing of concrete. Admixtures containing calcium chloride shall not be used.

8.2.3 Retarder: A retarding admixture shall meet the requirements of ASTM C 494, Type B, except that the 6-month and 1-year compressive strength tests are waived. The use of the admixture is at the option of the Contractor.

8.2.4 Water-Reducer: A water-reducing admixture shall meet the requirements of ASTM C 494, Type A or D except that the 6-month and 1-year compressive strength tests are waived. The admixture may be added to the concrete mixture only when its use is approved or directed.

### 8.3 Curing Materials:

8.3.1 Impervious sheet materials shall conform to ASTM C 171, type optional, except polyethylene film, if used, shall be white opaque.

8.3.2 Membrane-forming curing compounds shall be white pigmented compounds conforming to CRD-C 300.

8.4 Dowels: Dowels shall be fabricated or cut to length at the shop or mill before delivery to the site. Dowels shall be free of loose flaky rust and loose scale and shall be clean and straight. Dowels may be sheared to length provided that the deformation from true shape caused by shearing does not exceed 0.04 inch on the diameter of the dowel and does not extend more than 0.04 inch from the end of the dowel. Dowels shall be plain steel bars conforming to ASTM A 615, grade 40 or 60; ASTM A 616, grade 50 or 60; or ASTM A 617, grade 40 or 60; or shall be steel pipe conforming to ASTM A 120, extra strong, as indicated. Split dowels shall be of the threaded type, of approved design. The external and internal threaded portion of the split dowels shall conform to the thread designation given in the tabulation below. When 3-piece split dowels are furnished, the minimum coupling length shall be as indicated below:

<u>Dowel Diameter</u> <u>Inches</u>	<u>Thread Designation</u>	<u>Minimum Coupling</u> <u>Length, Inches</u>
3/4	7/8 - 9 - UNC - 2A-RH	2
1	1-1/8 - 7 - UNC - 2A-RH	2-1/2
1-1/4	1-3/8 - 6 - UNC - 2A-RH	3
1-1/2	1-3/4 - 5 - UNC - 2A-RH	3-3/4
2	2-1/4 - 4-1/2 - UNC - 2A-RH	4-3/4
3	3-1/4 - 4 - UNC - 2A-RH	6-3/4

The minimum length of each external threaded portion of the split dowels shall not be less than the nominal diameter of the dowel. Split dowels when assembled in place shall be straight, with length as specified, and shall have all external threads enclosed. End faces of couplings and of female portions of split dowels shall be squared to assure proper alinement of the dowel during installation.

### 8.5 Joint Filler:

8.5.1 For Expansion Joints: Filler shall be preformed materials conforming to ASTM D 1751 or ASTM D 1752. Expansion joint sealant shall conform to Section C-02592.

#### 8.5.2 NOT USED

8.6 Reinforcement: All reinforcement shall be free from loose flaky rust, loose scale, oil, grease, mud, or other coatings that might reduce the bond with concrete. Removal of thin powdery rust and tight rust is not required. However, reinforcing steel which is rusted to the extent that it does not conform to the required dimensions or mechanical properties shall not be used.

8.6.1 Bar Mats: Bar mats shall conform to ASTM A 184. The bar members shall be billet, rail, or axle steel.

8.6.2 Wire Fabric: Welded steel wire fabric shall conform to ASTM A 185.

8.6.3 Deformed Wire Fabric: Welded deformed steel wire fabric shall conform to ASTM A 497.

8.7 Tie Bars: Tie bars shall be deformed steel bars conforming to ASTM A 615, A 616, or A 617, and of the sizes and dimensions indicated. Deformed rail steel bars and high-strength billet or axle steel bars, grade 60 or higher, shall not be used for bars that are bent and straightened during construction.

8.8 Epoxy Resin: All epoxy resin materials shall be two-component materials conforming to the requirements of ASTM C 881, class as appropriate for each application temperature to be encountered, except that in addition, the materials shall meet the following requirements:

8.8.1 All materials shall have a 24-hour absorption not greater than 1 percent.

8.8.2 The materials for bonding freshly mixed portland cement concrete or mortar or freshly mixed epoxy resin concrete or mortar to hardened concrete shall be Type V materials, grade as approved.

8.8.3 The materials for use as patching materials for complete filling of spalls, wide cracks, and other voids; for use for embedding dowels and anchor bolts; and for use as a binder in preparing epoxy resin mortars and concretes shall be Type III materials and shall in addition meet these requirements: (a) the bond strength at 14 days (moist cure) shall be at least 1000 psi, and (b) the volatile content, cured system, shall not exceed 3 percent. Material for use for embedding dowels and anchor other bolts shall be Type IV, Grade 3. Material for injecting cracks shall be Type IV, Grade 1.

8.9 Water: Water for washing aggregates and for mixing and curing concrete shall be fresh and free from injurious amounts of oil, acid, salt, alkali, organic matter, or other deleterious substances and shall comply with CRD-C 400.

#### 8.10 Coarse Aggregate:

8.10.1 Composition: Coarse aggregate shall consist of crushed stone.

8.10.2 Quality: Aggregates as delivered to the mixers shall consist of clean, hard, uncoated particles meeting the requirements of ASTM C 33 and additional requirements as described in these specifications. Dust and other coating shall be removed from the coarse aggregates by washing.

8.10.3 Particle Shape: Particles of the coarse aggregate shall be generally spherical or cubical in shape. The quantity of flat and elongated particles in any size group shall not exceed 20 percent by weight as determined by CRD-C 119. A flat particle is defined as one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3.

8.10.4 Size and Grading: The nominal maximum size of the coarse aggregate shall be 1-1/2 inches. When the nominal maximum size is greater than 1 inch, the aggregates shall be furnished in two size groups as follows:

<u>Maximum Nominal Size Inches</u>	<u>Size Group</u>
1-1/2	No. 4 to 3/4-inch 3/4-inch to 1-1/2 inches

The grading of the coarse aggregate within the separated size groups shall conform to the requirements of ASTM C 33, Sizes 67 and 4 as delivered to the mixer.

8.10.5 Deleterious Substances: The amount of deleterious substances in each size group of coarse aggregate shall not exceed the limits shown below, determined in accordance with ASTM C 117, ASTM C 123, ASTM C 142, ASTM C 295, and ASTM C 851, applicable only to material coarser than 3/8-inch.

LIMITS OF DELETERIOUS SUBSTANCES IN COARSE AGGREGATE FOR HARDSTANDS  
(\* Percentage by Weight)

Sodium Sufate	12.0
Clay lumps and friable particles	2.0
Material finer than No. 200 sieve	1.0
Lightweight particles	1.0
Other soft particles	2.0

\* The total of all deleterious substances shall not exceed 5.0 percent of the weight of the aggregate. The percentage of material finer than No. 200 sieve shall not be included in this total. The limit for material finer than No. 200 sieve will be increased to 1.5 percent for crushed aggregates consisting of crusher dust that is essentially free from clay or shale. The separation medium shall have a specific gravity of 2.0.

8.11 Fine Aggregate:

8.11.1 Composition: Fine aggregate shall consist of manufactured sand or naturally deposited sand and shall be composed of clean, hard, durable particles.

8.11.2 Particle Shape: Particles of the fine aggregate shall be generally spherical or cubical in shape.

8.11.3 Grading: Grading of the fine aggregate, as delivered to the mixer, shall conform to the requirements of ASTM C 33.

In addition, the fine aggregate, as delivered to the mixer, shall have a fineness modulus of not less than 2.40 nor more than 2.90. The grading of the fine aggregate also shall be controlled so that the fineness moduli of at least nine of ten samples of the fine aggregate, as delivered to the mixer, will not vary more than 0.15 from the average fineness moduli of all samples previously taken. The fineness modulus shall be determined by CRD-C 104.

8.11.4 Deleterious Substances: The amount of deleterious substances in the fine aggregate shall not exceed the following limits:

<u>Material</u>	<u>Percentage by Weight</u>
Clay lumps and friable particles	1.0
Material finer than No. 200 sieve	3.0
Lightweight particles	0.5

The total of all deleterious materials shall not exceed 3.0 percent of the weight of the aggregate.

#### 9. MIXTURE PROPORTIONING:

9.1 Composition: Concrete shall be composed of cementitious material, water, fine and coarse aggregates, and admixtures. The cementitious materials shall be portland cement, or portland pozzolan cement or portland cement in combination with pozzolan. The admixture shall be an air-entraining admixture or may be an air-entraining admixture plus either a retarding admixture, a water-reducing admixture, or an accelerator as approved or directed. The Contractor's mix design will be submitted for Government approval 60 days prior to concrete paving operations. The submittal will include the 14 day flexural strengths.

9.2 Testing: As part of the mixture proportioning program, the proposed concrete mixture shall be subjected to testing according to ASTM C 1260. The test shall be conducted as specified but for the following exceptions: the cement portion specified in the procedure shall be replaced by cement and fly ash at the proportions to be used in the concrete, and the test shall be conducted once using the proposed fine aggregate and once using the proposed coarse aggregate crushed to the proper gradation. The maximum allowable expansion will be 0.10% at 16 days after casting. Test results not meeting this criteria will result in adjustment of the mixture proportions to reduce expansion or substitution of alternate aggregate(s). The Contractor shall supply all materials to Waterways Experiment Station, 3909 Halls Ferry Rd., Vicksburg, MS, 39180. The Government will bear the costs for this testing.

9.3 Control: The proportions of all material entering into the concrete will be furnished by the Contractor. The proportions will be changed as necessary to maintain the workability, strength, and standard of quality required for the concrete covered by these specifications, and to meet the varying conditions encountered during the construction. The Contracting Officer shall be notified before any changes are made to the proportions of materials.

9.4 Cement Content: The cement content of the concrete will be that necessary to meet the strength requirements specified. Pozzolan in the form of Class F fly ash shall be used in the concrete at a minimum content of 20 percent by volume.

9.5 Aggregate Content: The amount of each type aggregate used in the concrete mixture shall be as determined by the mixture proportioning studies.

9.6 Flexural Strength: Proportioning requirements for concrete shall be designed for a minimum flexural strength of 650 psi at 28 day age when tested in accordance with ASTM C 78.

9.7 Air Content: The air content by volume based on measurements made immediately after discharge from the mixer shall be 6 percent plus or minus 1-1/2 percent when determined in accordance with ASTM C 231 or with ASTM C 173 for concrete made with slag aggregates.

9.8 Slump: The concrete slump shall be between 1 and 1-1/2 inches when slip form equipment is used and between 1 and 3 inches if fixed form methods are used. Slump will be determined in accordance with ASTM C 143.

## PART 3 - EXECUTION

### 10. PRODUCTION OF CONCRETE:

10.1 Location of Plant: The batching plant or central mixing plant shall be located off the Government premises as approved.

10.2 Capacity: Each concrete mixer shall have a capacity of not less than 5 cubic yards. Batching, mixing, and hauling equipment shall have a capacity sufficient to maintain a forward movement of the paver of not less than 2.5 fpm.

10.3 Batching Plant: The batching plant shall conform to the requirements of CRD-C 95 and as specified; however, rating plates attached to batch plant equipment are not required. The batch plant shall be equipped with automatic recorders.

10.3.1 Equipment: The batching controls shall be either semiautomatic or automatic. Semiautomatic batching system shall be provided with interlocks. Separate bins or compartments shall be provided for each size group of aggregate, pozzolan, and cement. If both cement and pozzolan are used, they may be batched cumulatively provided portland cement is batched first. If measured by weight, water shall not be weighed cumulatively with another ingredient. Water batcher filling and discharging valves shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. An accurate mechanical device for measuring and dispensing each admixture shall be provided. Each dispenser shall be interlocked with the batching cycle and discharged automatically in a manner to obtain uniform distribution throughout the batch in the specified mixing period. Where use of truck mixers makes this requirement impracticable, the admixture dispensers shall be interlocked with the sand batches. The plant shall be arranged so as to facilitate the inspection of all operations at all times. Suitable facilities shall be provided for obtaining representative samples of aggregates from each bin or compartment.

10.3.2 Scales: Adequate facilities shall be provided for the accurate measurement and control of each of the materials entering each batch of concrete. The weighing equipment shall conform to the applicable requirements of NBS Handbook 44, except that the accuracy shall be within 0.2 percent of scale capacity. The Contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring device. Each weighing unit shall include a visible springless dial, which shall indicate the scale load at all stages of the weighing operation or shall include a beam scale with a beam balance indicator that will show the scale in balance at zero load and at any beam setting. The indicator shall have an over and under travel equal to at least 5 percent of the capacity of the beam. The weighing equipment shall be arranged so that the concrete plant operator can conveniently observe the dials or indicators.

#### 10.3.3 Batching Tolerances:

10.3.3.1 Weighing Tolerances: Whichever of the following tolerances is greater shall apply, based on required scale reading.

<u>Materials</u>	<u>Percentage of Required Weight</u>	<u>Percentage of Scale Capacity</u>
Cement (and Pozzolan)	plus or minus 1	plus or minus 0.3
Aggregate	plus or minus 2	plus or minus 0.3
Water	plus or minus 1	plus or minus 0.3
Admixture	plus or minus 3	plus or minus 0.3

10.3.3.2 Volumetric Tolerances: For volumetric batching equipment, the tolerances that shall apply to the required volume of material being batched are (a) water - plus or minus 1 percent, and (b) admixtures - plus or minus 3 percent.

10.3.4 Moisture Control: The plant shall be capable of ready adjustment to compensate for the varying moisture contents of the aggregates and to change the weights of the materials being batched. An electric moisture meter complying with the provisions of CRD-C 143 shall be provided for measuring of moisture in the fine aggregate. The sensing element shall be arranged so that measurement is made near the batcher charging gate of the sand bin or in the sand batcher.

#### 10.4 Concrete Mixers:

10.4.1 General: The mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated on the manufacturer's data plate. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired.

10.4.2 Central Plant Mixers: Central plant mixers shall be tilting, nontilting, or vertical-shaft type and shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed.

10.4.3 Mixing Time and Uniformity: For concrete plant mixers, in the absence of uniformity data, the mixing time for each batch after all solid materials are in the mixer, provided that all of the mixing water is introduced before one-fourth of the mixing time has elapsed, shall be 1 minute for mixers having a capacity of 1 cubic yard. For mixers of greater capacity, this minimum time shall be increased 15 seconds for each additional cubic yard or fraction thereof. These mixing times are predicated on operation at a designated speed and proper introduction of materials into the mixer. The mixing time may be reduced, if so approved, to the minimum time required to meet all the uniformity requirements. Mixer performance tests in accordance with CRD-C 55 at the proposed reduced mixing times shall be performed, and the mixer shall meet the following requirements when tested in accordance with the CRD-C 55 as required in the paragraph CONTRACTOR QUALITY CONTROL:



Parameters Tested For:

Requirement, express as maximum permissible range in results of Tests and Samples taken from three locations in the concrete batch.

Weight per cubic foot of mortars calculated to an air-free basis, lb per cubic ft	2.0
Air content, volume percent of concrete	1.0
Slump, inches	1.0
Coarse aggregate content, portion by weight of each sample retained on No. 4 sieve, percent	6.0
Average compressive strength at 7 days for each sample based on average strength of all test specimens, percent	10.0
Water content, portion by weight of each sample passing No. 4 sieve, percent	1.5

10.4.4 Truck Mixers: Each truck shall be permanently marked with the volume of mixed concrete and the mixing and agitating speeds. Each truck shall be equipped with counters to determine the number of revolutions at mixing and agitating speeds. Concrete completely mixed in a truck mixer shall be mixed 70 to 100 revolutions at a designated mixing speed after all ingredients including mixing water have been charged into the drum. Concrete first partially intermingled in a concrete plant mixer (shrink-mixed) a minimum time as required to combine the ingredients shall then be completely mixed in a truck mixer. The number of revolutions between 70 to 100 for truck-mixed concrete and the number of revolutions for shrink-mixed concrete shall be determined by uniformity tests as specified in requirements for mixer performance stated in paragraph CONTRACTOR QUALITY CONTROL. If requirements for the uniformity of concrete are not met with 100 revolutions of mixing after all ingredients including water are in the drum, the mixer shall not be used until the condition is corrected. Additional revolutions beyond the number determined to produce the required uniformity shall be at a designated agitating speed. Water shall not be added after the initial introduction of mixing water, except when on arrival at the jobsite the slump is less than specified and the water-cement ratio is less than the approved mixture design permits. Additional water may be added to bring the slump within the specified range provided the approved water-cement ratio is not exceeded. Water shall be injected into the mixer under pressure, and the drum or blades shall be turned a minimum of 30 additional revolutions at mixing speed. Water shall not be added to the batch at any later time.

11. TRANSPORTING EQUIPMENT: Transportation of concrete mixed completely in a stationary mixer from the mixer to the point of placement shall be by truck agitator, in a truck mixer operating at agitator speed, or in nonagitating equipment. All transporting equipment shall conform to ASTM C 94, except as modified herein. Vehicles transporting concrete mixed partially or completely in stationary mixers and truck mixers used for complete concrete mixing shall be capable of delivering and discharging the concrete without segregation. Equipment shall be provided that is capable of transferring the concrete from the transporting vehicle and distributing the concrete without segregation into its final position. Placement shall be made alternately from both sides of the paving lane with chutes capable of delivering uniformly freshly mixed concrete

to the middle of the paving lane. Any concrete having a slump greater than 2 inches shall be removed from the job. If, upon trial, an unsatisfactory or segregated mixture is deposited, equipment shall be provided capable of transferring and distributing concrete without segregation into its final position in the form. When the stabilized subgrade or base course is of sufficient strength to support concrete transportation equipment without rutting or deformation, concrete may be discharged in front of the paver. The surface on which the pavement is being placed shall be maintained free from foreign materials or concrete that has begun to harden.

## 12. PLACING:

12.1 General: Concrete may be placed between stationary forms, or may be constructed to the desired cross section using slipform pavers. Concrete shall be deposited between the forms or placed with the slipform paver within 45 minutes from the time cement has been charged into the mixing drum. Concrete shall be deposited as close as possible to its final position in the pavement cross section. The placement of the concrete shall be continuous and at a uniform rate without unscheduled stops except for equipment failure or other emergencies. Workmen with foreign material on their footwear or construction equipment that might deposit foreign material shall not be permitted to walk or operate in the concrete during placement and finishing operations.

12.2 Slipform Method: The slipform paver shall be self-propelled, automatically controlled, crawler-mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in one pass. The paver shall be capable of finishing the surface and edges so that a minimum amount of hand finishing is required, and shall have sufficient weight and power to handle the amount of concrete required for the full-lane width as specified. The mechanisms for forming the pavement shall be easily adjustable in width and thickness. Horizontal alinement shall be referenced to a taut wire or string line. Vertical alinement shall be referenced to a taut wire or string line, to the surface of the underlying material, or to the surface of previously constructed pavement. The vibrators or tamping elements shall be automatically controlled so that they shall be stopped as forward motion ceases. When the paver approaches a header at the end of a paving lane, a sufficient amount of concrete shall be maintained ahead of the paver to allow a roll of concrete to spill over the header. The amount of extra concrete shall be sufficient to prevent the slurry that is formed and carried along ahead of the paver from being deposited adjacent to the header. The spud vibrators on the front of the paver should be brought as close to the header as possible before they are lifted. Additional consolidation shall be provided adjacent to the headers by hand-manipulated vibrators. When the slipform paver is operated between or adjacent to previously constructed pavement, provisions shall be made to prevent damage to the previously constructed pavement. Transversely oscillating screeds shall be electronically controlled from the previously placed pavement to prevent the screed from applying pressure to the existing pavement. When the paver travels on existing pavement, provisions shall be made to prevent damage to the existing pavement. Slipform pavers using transversely oscillating screeds shall not be used to form fill-in lanes that have widths less than a full width for which the paver was designed.

12.3 Spreading: Spreading shall be by machine method, except when transporting equipment is permitted on the underlying material, in which case the concrete may be discharged directly in front of the paver. When placed directly in front of the paver, the concrete shall be spread evenly across the full width of the paving lane. Hand spreading will be permitted only where required for odd widths or shapes of slabs. Hand spreading shall be done with shovels; rakes shall not be used. Mechanical spreaders shall be designed and operated to distribute the plastic concrete uniformly across the full width of the paving lane. Machines that cause displacement of properly installed forms or ruts or indentations in the prepared underlying material and machines that cause frequent delays due to

mechanical failures shall be replaced as directed. When the spreader rides the edges of previously constructed lanes, provisions shall be made to prevent damage to the previously constructed pavement. Where concrete is delivered to the form in truck mixers, suitable chutes may be used, provided windows cover essentially the entire area within the form. In no case is the dumping of concrete at one location and the running into place with vibration permitted. The spreading of concrete shall be performed at such elevations, slightly above grades, that when properly consolidated, the surface will be at the elevation indicated.

12.4 Vibration: Concrete shall be consolidated with mechanical vibrating equipment immediately after spreading. Vibrating equipment shall be of the internal type, and the number of units and the power of each unit shall be adequate to properly consolidate the concrete with the vibration spacing used. The vibrating unit shall be mounted on a frame or on the paver and equipped with suitable controls so that all vibrators may be operated at any desired depth within the slab or completely withdrawn from the concrete, as required. The spacing of vibrating units that extend into the slab at intervals across the paving lane shall be as necessary to properly consolidate the concrete, but the clear distance between the units shall not exceed 30 inches. The outside elements of the internal spud vibrator units shall be approximately 1 foot from the edge of the slab. Vibrators of this type shall be inserted into the concrete to a depth that will provide the best consolidation but not closer to the underlying material than 2 inches. Concrete in odd-shaped slabs or in locations inaccessible to the vibrating equipment above shall be vibrated with a hand-manipulated vibrator. Vibrators shall not be used to transport or spread the concrete in the forms. Spud vibrators shall operate at a frequency of not less than 8000 impulses per minute and tube vibrators at a frequency of not less than 5000 impulses per minute when in the concrete. Excessive vibration will not be permitted. Vibrators shall not be operated in the concrete at one location for more than 20 seconds. Forward motion of the paver shall cease as soon as a vibrator becomes inoperable and shall not start until the vibrator is repaired or replaced. At least one additional vibrator, or sufficient parts for replacing and repairing vibrators or vibrator assemblies for each paving train, shall be maintained at the site at all times.

12.5 Placing Reinforcing Steel: The type and amount of steel reinforcement shall be as shown on the contract drawings. Bar mat reinforcement shall be positioned on suitable chairs before concrete placement. Wire fabric and deformed wire fabric reinforcement shall be pushed down to its correct position by suitable vibratory equipment after the full depth of concrete has been placed. Regardless of the placement procedure, the reinforcing steel shall be free from coatings that could impair bond between the steel and the concrete, and laps in the reinforcement shall be as indicated.

12.6 Placing During Cold Weather: Concrete placement shall be discontinued when the air temperature reaches 40 degrees F and is falling. Placement may begin when the air temperature reaches 35 degrees F and is rising. Provision shall be made to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement shall be approved in writing. Approval shall be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water and/or aggregates shall be heated as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period. Concrete damaged by freezing shall be removed and replaced as specified in paragraph REMOVAL AND REPLACEMENT OF DEFECTIVE CONCRETE.

12.7 Placing During Hot Weather: During periods of hot weather when the maximum daily air temperature is likely to exceed 85 degrees F, the following precautions shall be taken. The forms and the underlying material shall be sprinkled with water immediately before placing the concrete. Concrete shall be placed at the coolest temperature practicable, and in no case shall the temperature of the concrete when placed exceed 90 degrees F. Aggregates and/or mixing water shall be cooled as necessary. Concrete shall be placed continuously and rapidly at a rate of not less than 100 feet of paving lane per hour. The finished surfaces of the newly laid pavement shall be kept damp by applying a waterfog or mist with approved spraying equipment until the pavement is covered by the curing medium. If necessary, wind screens shall be provided to protect the concrete from an evaporation rate in excess of 0.2 psf per hour.

13. FINISHING: Finishing operations shall be started immediately after placement of the concrete. Finishing shall be by the machine method except that where indicated; the hand method will be permitted on odd slab widths or shapes and in event of breakdown of the mechanical equipment to finish concrete. The sequence of operations shall be finishing, floating, straightedging, texturing, and then edging of joints. Finishing equipment and tools shall be maintained clean and in an approved condition.

#### 13.1 Machine Finishing with Fixed Forms:

13.1.1 Equipment: The finishing machines shall be of ample weight and power for proper finishing of the concrete. The finishing machine shall be designed and operated to strike off, screed, and consolidate the concrete. Screed and float adjustments of these machines shall be checked at the start of each day's paving operations and more often as required. Machines that cause displacement of side forms or that cause frequent delays due to mechanical failure shall be replaced. When finishing machines ride the edge of a previously constructed slab, provision shall be made to protect the surface of these slabs.

13.1.2 Transverse Finishing: As soon as placed, the concrete shall be accurately struck off and screeded to the crown and cross section shown and to such elevation that when consolidated and finished, the surface of the pavement will be free from porous places and will be at the required grade. The finishing machine shall make as many trips over each area of pavement as necessary to compact the concrete and produce a surface of uniform texture, true to grade. Water shall not be added to the concrete used to fill low spots or to facilitate finishing operations. Excessive manipulation that brings mortar and water in excess of 1/8-inch thick to the surface will not be permitted, and any equipment that cannot produce the required compaction and surface finish without an excessive number of trips will be considered unsatisfactory. The top of the form or pavement edge upon which the finishing machine travels shall be kept clean.

13.1.3 Mechanical Floating: After completion of screeding, the mechanical float may be operated to smooth and finish the pavement to grade. The float shall be operated so as to maintain contact with the surface at all times. If required, additional concrete shall be placed and screeded, and the float operated over the same area until a satisfactory surface is produced.

13.1.4 Other Types of Finishing Equipment: Concrete finishing equipment of types other than specified above may be used on a trial basis. The use of equipment that fails to produce finished concrete of the quality and consistency required by these specifications shall be discontinued, and the concrete shall be finished with approved equipment and in the manner specified above.

13.2 Finishing by Slipform Method: The slipform paver shall be capable of finishing the surface and edges so that only a minimum of additional work is necessary. A self-propelled pipe float may be used if the Contractor desires, while the concrete is still plastic, to remove minor irregularities and score marks. Straightedge finishing may be used as required; however, its use shall

be kept to a minimum. The pipe float shall be 6 to 10 inches in diameter and sufficiently long to span the full paving width when oriented at an angle of approximately 60 degrees with the center line. Pipe floating should be accomplished as soon as possible and discontinued immediately after a uniform surface appearance is achieved. The addition of water to the concrete surface during finishing operations will not be permitted. The Contractor must limit his finishing operations so that the concrete surface is not overworked. Concrete slurry permitted to run down the vertical edges of the slipped concrete will be removed by hand, using stiff brushes or other approved scrapers. Concrete slurry will not be used to build up along the edges of the concrete to compensate for excessive edge slump. Wood or metal forms shall be available for use in repairing edges that slough excessively. In locations where excessive sloughing occurs, the wood or metal forms shall be securely attached to the underlying material in the proper location, and the defective edges corrected to the permissible tolerances. These procedures are to be used sparingly, and should excessive sloughing occur, operations will be halted until proper corrective adjustments have been made. Such procedures are not to be considered as routine corrective measures for edge instability.

### 13.3 Hand Finishing:

13.3.1 Equipment: A strike and tamping template and a longitudinal float shall be provided for hand finishing. The template shall be at least 1 foot longer than the width of pavement being finished, of an approved design, and sufficiently rigid to retain its shape, and shall be constructed of metal or other suitable material shod with metal. The longitudinal float shall be at least 10 feet long, of approved design, and rigid and substantially braced, and shall maintain a plane surface on the bottom of the base.

13.3.2 Finishing and Floating: As soon as placed and vibrated, the concrete shall be struck off and screeded to the crown and cross section and to such elevation above grade that when consolidated and finished, the surface of the pavement will be at the required elevation. The entire surface shall be tamped, and the tamping operation continued until the required compaction and reduction of internal and surface voids are accomplished. Immediately following the final tamping of the surface, the pavement shall be floated longitudinally from bridges resting on the side forms and spanning but not touching the concrete. If necessary, additional concrete shall be placed and screeded, and the float operated until a satisfactory surface has been produced. The floating operation shall be advanced not more than half the length of the float and then continued over the new and previously floated surfaces.

13.4 Surface Correction and Testing: After finishing is completed but while the concrete is still plastic, minor irregularities and score marks in the pavement surface shall be eliminated by means of straightedges. Straightedges shall be 12 feet in length and shall be operated from the sides of the pavement and from bridges. A straightedge operated from the side of the pavement shall be equipped with a handle 3 feet longer than one-half the width of the pavement. The surface shall then be tested for trueness with a 12-foot straightedge held in successive positions parallel and at right angles to the center line of the pavement, and the whole area covered as necessary to detect variations. The straightedge shall be advanced along the pavement in successive stages of not more than one-half the length of the straightedge. Depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. Projections above the required elevation shall also be struck off and refinished. The straightedge testing and finishing shall continue until the entire surface of the concrete is free from observable departure from the straightedge and conforms to the surface requirements specified in paragraph EVALUATION AND ACCEPTANCE.

13.5 Texturing: Before the surface sheen has disappeared and before the concrete becomes nonplastic, the surface of the pavement shall be given a texture as follows:

Broom Texturing: Surface texture shall be applied using an approved hand or mechanical stiff bristle broom of a type that will produce uniform corrugations. For hand brooming, the brooms shall have handles longer than half the width of slab to be finished. The hand brooms shall be drawn transversely across the surface from the center line to each edge with slight overlapping strokes. For mechanical operations, the broom shall be operated with the length of the broom parallel to the pavement center line. The broom shall be capable of traversing the full width of the pavement in a single pass at a uniform speed and with a uniform pressure. Successive passes of the broom shall be overlapped the minimum necessary to obtain a uniformly textured surface. Brooms shall be washed thoroughly and dried at frequent intervals during use. Worn or damaged brooms shall be removed from the jobsite. Brooming should be completed before the concrete has dried to the point where the surface will be unduly torn or roughened, but after drying has progressed enough so that the mortar will not flow and attenuate the sharpness of the corrugations. In general the corrugations should be uniform in appearance and approximately 1/16-inch in depth but not more than 1/8-inch in depth.

13.6 Edging: After texturing has been completed, the edge of slabs along the forms, along the edges of slipformed lanes and at the joints, where indicated or directed, shall be carefully finished with an edging tool to form a smooth rounded surface of the required radius. Tool marks shall be eliminated, and the edges shall be smooth and true to line.

13.7 Outlets in Pavement: Recesses for the hardstand static grounds and other outlets in the pavement shall be constructed to conform to the details and dimensions shown. The concrete in these areas shall be carefully finished to provide a surface of the same texture as the surrounding area that will be within the requirements for plan grade and surface smoothness stated in paragraph EVALUATION AND ACCEPTANCE.

14. FORM REMOVAL: Forms shall remain in place at least 12 hours after the concrete has been placed. When conditions are such that the early-strength gain of the concrete is delayed, the forms shall be left in place for a longer period as directed. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly satisfactorily repaired.

#### 15. CURING:

15.1 General: Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period. If any selected method of curing does not afford the proper curing and protection against concrete cracking, the damaged pavement will be removed and replaced, and another method of curing shall be employed as directed.

15.2 Membrane Curing: A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water, and the curing compound applied as soon as the free water disappears. The curing compound shall be applied to the finished surfaces by means of an approved automatic spraying machine. The spraying machine shall be self-propelled and

shall straddle the newly paved lane. The machine shall have one or more spraying nozzles that can be controlled and operated to completely and uniformly cover the pavement surface with the required amount of curing compound. The curing compound in the drum used for the spraying operation shall be thoroughly and continuously agitated mechanically throughout the full depth of the drum during the application. Air agitation may be used only to supplement mechanical agitation. Spraying pressure shall be sufficient to produce a fine spray as necessary to cover the surface thoroughly and completely with a uniform film. Spray equipment shall be maintained in first-class mechanical condition, and the spray nozzle shall have an adequate wind guard. The curing compound shall be applied with an overlapping coverage that will give a two-coat application at a coverage of not more than 400 square feet per gallon for each coat. The application of curing compound by hand-operated pressure sprayers will be permitted only on odd widths or shapes of slabs where indicated and on concrete surfaces exposed by the removal of forms. When the application is made by hand-operated sprayers, the second coat shall be applied in a direction approximately at right angles to the direction of the first coat. The compound shall form a uniform, continuous, cohesive film that will not check, crack, or peel and that will be free from pinholes and other discontinuities. If pinholes, abrasions, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed. Necessary precautions shall be taken to insure that the concrete is properly cured at sawed joints, but that no curing compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed before the concrete in the region of the joint is resprayed with curing compound. The method used for sealing the joint groove shall prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement shall be provided at an accessible location at the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

#### 16. JOINTS:

16.1 General: Joints shall conform to the details indicated and shall be perpendicular to the finished grade of the pavement. Transverse expansion and contraction joints shall be straight and continuous from edge to edge of the pavement.

16.2 Longitudinal Construction Joints: Longitudinal construction joints between paving lanes shall be located as indicated. Dowels shall be installed in the longitudinal construction joints. Dowels shall be installed in conformance with paragraph DOWELS AND TIE BARS. Longitudinal construction joints shall be edged and subsequently sawed to provide a groove at the top conforming to the details and dimensions indicated.

16.3 Transverse Construction Joints: Transverse construction joints shall be installed at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for 30 minutes or longer. These joints shall be located at a planned joint, except in case of equipment breakdown. When concrete placement cannot be continued, the transverse construction joint may be installed within the slab unit but not less than 10 feet from a planned transverse joint. Transverse construction joints shall be doweled as shown. When the construction joint is located at planned transverse joints, one-half of each dowel shall be painted and oiled to permit movement at

the joint. These joints shall be edged and subsequently sawed to provide a groove at the top conforming to the details and dimensions indicated. When concrete placement is resumed, the planned joint spacing shall be used beginning with the first regularly scheduled transverse joint. When using slipform pavers, transverse construction joints shall be constructed by utilizing headers, hand placement, and finishing techniques. Pavement shall be constructed with the slipform paver as close to the header as possible and run out completely past the header.

16.4 Expansion Joints: Expansion joints shall be formed by means of a preformed filler material. The filler shall be securely held in position by means of approved metal supports, which shall remain in the pavement. A removable metal-channel cap bar shall be used to hold the parts of the joint in proper position and protect the filler from damage during concreting operations. The cap bar shall be removable without damage to the pavement to provide a space for sealing of the joint. Adjacent sections of filler shall be fitted tightly together, and the filler shall extend across the full width of the paving lane in order to prevent entrance of concrete into the expansion space. Expansion joints shall be formed about structures and features that project through, into, or against the pavement, using joint filler of the thickness and width indicated, and shall be installed in such manner as to form a complete, uniform separation between the structure and the pavement.

16.5 Contraction Joints: Transverse and longitudinal contraction joints shall be of the weakened-plane or dummy type and shall be constructed as indicated. Longitudinal contraction joints shall be constructed by sawing a groove in the hardened concrete with a power-driven saw in conformance with requirements for sawed joints unless otherwise approved. Transverse contraction joints shall be constructed in conformance with requirements for sawed joints or insert-type contraction joints, unless otherwise approved.

16.5.1 Sawed Joints: Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8-inch blade to the full depth as indicated. After expiration of the curing period, the upper portion of the groove shall be widened by sawing to the width and depth indicated. The time of sawing shall vary depending on existing and anticipated weather conditions and shall be such as to prevent uncontrolled cracking of the pavement. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit cutting the concrete without chipping, spalling, or tearing. The sawed faces of joints will be inspected for undercutting or washing of the concrete due to the early sawing, and sawing shall be delayed if undercutting is sufficiently deep to cause structural weakness or excessive roughness in the joint. The sawing operation shall be carried on as required during both day and night regardless of weather conditions. The joints shall be sawed at the required spacing consecutively in the sequence of the concrete placement. A chalk line or other suitable guide shall be used to mark the alinement of the joint. The saw cut shall not vary more than 1/2-inch from the true joint alinement. Before sawing a joint, the concrete shall be examined closely for cracks, and the joint shall not be sawed if a crack has occurred near the planned joint location. Sawing shall be discontinued when a crack develops ahead of the saw cut. Workmen and inspectors shall wear clean, rubber-soled footwear, and the number of persons walking on the pavement shall be limited to those actually performing the sawing operation. Immediately after the joint is sawed, the saw cut and adjacent concrete surface shall be thoroughly flushed with water until all waste from sawing is removed from the joint. Any membrane-cured surface damaged during the sawing operations shall be resprayed as soon as the surface becomes dry. The sawing equipment shall be adequate in the number of units and the power to complete the sawing at the required rate. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operation.



16.5.2 Insert-Type Contraction Joints: Insert-type contraction joints shall be constructed by installing a preformed insert in the plastic concrete to form a weakened plane to induce cracking. The insert materials shall conform to ASTM D 2628, D 2828, or CRD-C 572, whichever is applicable. Inserts shall be constructed so that the insert material can be removed to form a groove in the concrete as required. All types of inserts shall be approved before installation. Inserts shall be furnished in heights for the various depths of joints shown and in lengths equal to the width of the paving lane.

16.5.2.1 Equipment: The equipment for installing inserts shall be a machine equipped with a vibratory bar for cutting a groove in the plastic concrete for placement of the insert or for vibrating the insert into place at the prescribed joint location. Installation of the insert shall be to the required depth throughout the full width of the paving lane. Vibration units shall be so arranged that the vibration will be uniformly distributed throughout the bar. The intensity of vibration shall be adjustable as necessary to form a groove of proper size for the filler or for forcing the insert into the plastic concrete and consolidating the concrete around the in-place insert. For concrete placed by slipform pavers, the edges of the plastic concrete must be supported to prevent slumping during the vibration and placement of inserts. The vibratory float shall be used following placement of the insert material in lieu of hand floating or troweling the finish.

16.5.2.2 Installation of Inserts: The insert shall be installed in the plastic concrete immediately following the final machine finishing with a maximum of two joint spacings between the finishing machine and the inserter. Additional straightedge and texturing operations shall be accomplished without disturbing the installed insert. Adjacent sections of the joint inserts within each slab unit shall be securely joined together, and the insert shall extend across the full width of the slab. The concrete shall be thoroughly consolidated against and for the full depth of the insert. The insert shall be perpendicular to the finished grade of the pavement and shall be straight in alinement at the prescribed joint locations shown, with the top of the insert flush or not more than 1/8-inch below the pavement surface. The insert equipment shall be available on the job in good condition before placement of concrete to insure proper vibration and floating.

16.5.2.3 Sawing Inserts: After the expiration of the curing period a groove for the joint sealer shall be formed as specified below. The top portion of fiberboard fillers or sawable preformed inserts shall be removed by sawing with a power saw to form a groove of required dimensions. The sawing shall be so accomplished as to abrade the concrete surfaces in the joint groove and remove all traces of the filler or insert. Nonsawable insert material shall be removed as prescribed by the manufacturers. The dimensions and characteristics of the groove thus formed shall be as shown. The grooves shall have edges free of ravels and spalls. The grooves shall be straight from edge to edge of the pavement and shall not vary more than 1/2-inch from the alinement.

## 17. DOWELS AND TIE BARS:

17.1 Fixed-Form Installation: Fixed-form installation of dowels and tie bars shall be by the bonded-in-place method. Tie bars and dowels shall be prepared and placed across joints where indicated, correctly aligned, and securely held in the proper horizontal and vertical position during placing and finishing operations, except that tie bars specified along longitudinal contraction joints may be installed in front of the paver by insertion into the unconsolidated concrete. Installation by removing and replacing dowels in preformed holes will not be permitted. Dowels in longitudinal and transverse construction joints shall be held securely in place parallel to the surface, as indicated, by means of devices fastened to the form. Dowels in expansion joints and tie bars and dowels installed within the paving lane shall be held securely in place, as indicated, by means of rigid metal frames or basket assemblies of approved type.

The assemblies shall consist of a framework of metal bars or wires arranged to provide rigid support for the dowels and the tie bars throughout the paving operation, with a minimum of four continuous bars or wires extending across the paving lane. The dowels shall be welded to the assembly or held firmly by mechanical locking arrangements that will prevent the dowels from rising, sliding out, or becoming distorted during paving operations. The dowel assemblies shall be held securely in the proper location by means of suitable pins or anchors. When split dowels are used, the female portion of the split dowel shall be bonded in the initially placed pavement lane. The female portion of the split dowel shall be securely fastened to the pavement form and shall maintain the proper position and alinement of the dowel during concrete placement so that no mortar or other foreign material will enter the socket or coupling. Before the split dowels are assembled, the external and internal threads shall be cleaned thoroughly to remove all cement, cement mortar, grit, dirt, and other foreign matter. In the final assembly, a minimum torque of 200 ft-lbs shall be applied. The spacing of dowels in longitudinal construction joints shall be as indicated, except that where the planned spacing cannot be maintained because of form length or interference with form braces, closer spacing with additional dowels shall be used. Dowels in longitudinal joints shall be omitted when the center of the dowel is located within a horizontal distance from a transverse joint equal to one-fourth of the slab thickness. The method used in holding dowels in position shall develop such accuracy that the error in alinement of any dowel from its required position after the pavement has been finished shall be not greater than 1/8-in/ft. The Contractor shall furnish an approved template for checking the position of the dowels. The portion of each dowel intended to move within the concrete or expansion cap shall be painted with one coat of red lead or blue lead paint. The painted portion shall be wiped clean and coated with a thin even film of lubricating oil before the concrete is placed. Pipe used as dowels shall be filled with a stiff sand-asphalt mixture or portland cement mortar, or the ends of the pipe dowels shall be fitted with tight-fitting plugs of an approved material extending into the pipe.

17.2 Slipform Installation: For concrete placed using slipform pavers, dowels, and tie bars shall be placed in horizontal and vertical positions across the joints where indicated. Dowels in longitudinal construction joints shall be placed by bonding the dowels into holes drilled into the hardened concrete. No drilling will be allowed until the concrete has reached a minimum flexural strength of 500 psi. When the grouted in-place method is used, holes approximately 1/8-inch greater in diameter than the dowels shall be drilled with rotary-type core drills that must be held securely in place to drill perpendicularly into the vertical face of the pavement slab. Dowels shall be bonded in the drilled holes using an epoxy resin material as specified in paragraph MATERIALS. Installation procedures shall be adequate to insure that the area around dowels is completely filled with epoxy grout. Dowels in expansion and contraction joints installed within the paving lane shall be held securely in place by means of rigid metal frames or basket assemblies of the type used in the method described in requirements for fixed-form installation. This method used for installing and maintaining dowels in position shall develop such accuracy that the error in alinement of any dowel from its required position shall be not greater than 1/8-in/ft. The Contractor shall furnish a template for checking the position of the dowels. Tie bars installed within the paving lane shall be held securely in place by means of rigid metal frames or basket assemblies of approved type as required by fixed-form installation.

18. SEALING JOINTS: Joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Sawing of filler-type joints shall be accomplished immediately before sealing of the joints. Joints shall be sealed as specified in SECTION C-02760.

19. REMOVAL AND REPLACEMENT OF DEFECTIVE CONCRETE: Defective concrete shall be removed and replaced as specified herein with pavements of the thickness and quality required by these specifications. In no case shall the removal and

replacement of concrete result in a slab less than the full paving lane width or a joint less than 10 feet from a regularly scheduled transverse joint. The defective concrete shall be removed carefully so that the adjacent pavement will not be damaged and the existing dowels at the joints will be left intact. When a portion of the unfractured slab is replaced, a saw cut 4 inches deep shall be made transversely across the slab in the required location, and the concrete shall be removed to provide an essentially vertical face in the remaining portion of the slab. Prior to placement of the fresh concrete, the face of the slab shall be cleaned of debris and loose concrete, and then thoroughly coated with epoxy-resin. The epoxy-resin coating shall be applied by scrubbing a thin coat into the surface with a stiff-bristle brush. Strips of polyethylene sheeting shall be placed on the vertical joint faces of adjacent slabs at the juncture with the slab to be patched as a bond-breaking medium. Placement of the fresh portland cement concrete shall be accomplished while the epoxy resin is still tacky and in such manner that the grout coating will not be removed. Longitudinal and transverse joints of the replaced slab or portion thereof shall be constructed as indicated. The joints shall be sealed as specified in SECTION C-02760. The replaced pavements will be paid for at the contract price, but no payment will be made for the defective pavements removed or for the cost of removing the defective pavements.

## 20. NOT USED

21. PAVEMENT PROTECTION: The Contractor shall protect the pavement against all damage prior to final acceptance of the work by the Government. Traffic shall be excluded from the pavement by erecting and maintaining barricades and signs until the concrete is at least 14 days old, or for a longer period if so directed. As a construction expedient in paving intermediate lanes between newly paved lanes, operation of the hauling equipment will be permitted on the pavement after the pavement has been cured for 7 days and the joints have been sealed or otherwise protected. Also, the subgrade planer, concrete finishing machines, and similar equipment may be permitted to ride upon the edges of previously constructed slabs when the concrete has attained a minimum flexural strength of 400 psi and adequate means are furnished to prevent damage to the slab edge. The pavement carrying traffic or equipment shall be kept clean, and spillage of materials or concrete shall be cleaned up immediately upon occurrence. For fill-in lanes, equipment will be used that will not damage or spall the edges or joints of the previously constructed pavement.

21.1 Specimens for Determining Time of Opening Pavement: Test groups of at least three beams shall be taken, as required, from concrete placed in designated areas. The beams of each test group shall be made from a single batch of concrete. The test beams shall be cured in accordance with ASTM C 31.

## 22. CONTRACTOR QUALITY CONTROL:

22.1 General: The Contractor shall perform the inspection and tests described and meeting the requirements for inspection details and frequency of testing specified. Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met. The Contractor will submit a certificate of aggregate quality compliance with criteria data listed in paragraphs 8.10 and 8.11 of this section. The certificate will contain test results from current aggregate production and be from a certified testing laboratory meeting the requirements of ASTM C-1077. The certificates will be submitted within 14 days after the Notice to Proceed.

22.2 Inspection Details and Frequency of Testing: The following number of tests will be the minimum acceptable for each type of operation:

### 22.2.1 Fine Aggregate:

22.2.1.1 Grading: Twice during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 and CRD-C 104 for the fine aggregate (or for each fine aggregate, if it is batched in more than one size of classification). The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits.

22.2.1.2 Fineness Modulus Control Chart: Results of the fineness modulus determination shall be grouped in sets of three consecutive tests, and the average and range of each group plotted on a control chart. The upper and lower control limits for the average shall be drawn 0.10 units above and below the average fineness modulus of all samples previously taken, and the upper control limit for the range shall be 0.28.

22.2.1.3 Moisture Content: In the opinion of the Contracting Officer, when the electric moisture meter is not operating satisfactorily, at least two pairs of tests for moisture content in accordance with ASTM C 70, ASTM C 566, or CRD-C 112 will be made during each 8-hour period of mixing plant operation. The two tests in each pair shall be spaced 1 hour apart, and the times for the pairs shall be selected randomly within the shift. An additional test shall be made whenever the slump is shown to be out of control or excessive variation in workability is reported by the placing foreman. (When the electric moisture meter is operating satisfactorily, at least two direct measurements of moisture content shall be made per week to check the calibration of the meter. Variability within a 1- or 8-hour period may be determined by meter readings.)

#### 22.2.2 Coarse Aggregate:

22.2.2.1 Grading: Twice during each shift in which the concrete plant is operating a sieve analysis shall be made in accordance with ASTM C 136 for each size of coarse aggregate. Samples shall be taken from the batch plant bins. Each test record shall show the results of the current test as well as the average results of the five most recent tests including the current test. Tests at other locations, when necessary for control, shall be recorded also. For these tests the Contractor may adopt limits for control coarser than the specification limits to allow for degradation during handling. Where facilities are available to test samples five times as large as those required in ASTM C 136, no averaging is necessary. When, in the opinion of the Contracting Officer, a problem exists in connection with coarse aggregate particle shape, daily tests shall be made in accordance with CRD-C 119.

22.2.2.2 Moisture Content: A test for moisture content of each size of coarse aggregate shall be made at least once a shift. When two consecutive readings for the smallest size coarse aggregate differ by more than 1 percent, the frequency of testing shall be increased to that specified for fine aggregate.

22.2.3 Scales: The accuracy of the scales shall be checked by test weights, as directed by the Contracting Officer, for conformance with the applicable requirements of NBS Handbook 44. Such tests shall be made whenever there are variations in properties of the fresh concrete, which could result from batching errors. Once a week the accuracy of each batching device shall be checked during a weighing operation by noting and recording the required weight and the actual weight batched.

22.2.4 Batch-Plant Control: When the concrete plant is operating, the measurement of all constituent materials including cement, each size of aggregate, water, and admixtures shall be continuously controlled. The aggregate weights and the amount of water added to compensate for free moisture in the aggregates shall be adjusted as necessary. The amount of the air-entraining agent shall be adjusted to control the air content within specified limits. A

report shall be prepared indicating the type and source of cement used, the amount and source of admixtures used, the aggregate source, the required aggregate and water weights per cubic yard, the amount of water as free moisture in each size of aggregate, and the batched aggregate and water weights per cubic yard for each class of concrete batched during the plant operation.

#### 22.2.5 Concrete:

22.2.5.1 General: Concrete samples shall be furnished by the Contractor and shall be taken by the Contractor in the field to determine the slump, air content, and strength of the concrete. Test beams shall be made for determining conformance with the strength requirements of these specifications and, when required, for determining the time at which pavements may be placed into service. The air content shall be determined in accordance with ASTM C 231. Slump tests shall be made in accordance with ASTM C 143. Test beams shall be molded and cured in accordance with ASTM C 31 and as specified below. Steel beam molds shall be used for molding the specimens. The Contractor shall furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test beams at the site. Curing facilities for test beams shall include furnishing and operating water tanks equipped with temperature-control devices that will automatically maintain the temperature of the water at 73 plus or minus 5 degrees F. The Contractor shall furnish and maintain at the site boxes or other facilities suitable for storing the specimens while in the mold at a temperature of 73 plus or minus 10 degrees F. Tests of the fresh concrete and of the hardened concrete beams will be made by and at the expense of the Contractor.

22.2.5.2 Specimens for Strength Tests: One set of six test beams shall be made for each 500 cubic yards, or fraction thereof, as directed by the Contracting Officer. However, at the start of paving operation and when the aggregate source, aggregate characteristics, or mixture proportions are changed, additional groups of test beams may be required until the Contracting Officer is satisfied that the concrete mixture being used complies with the strength requirements of these specifications. Test ages will be 7, 14, and 28 days. Specimens shall be tested in accordance with ASTM C 78. The test results shall show that 80 percent of the consecutive individual tests equal or exceed 600 psi at 14-day age. If the average of any five consecutive 14-day strengths or more than 20 percent of the individual tests is less than 600 psi, the mixture proportions shall be changed to increase the strength. The average of any five consecutive 28-day strengths shall equal or exceed 650 psi. Seven-day strengths shall be taken for the purposes of determining the early strength of concrete for construction loading and are not to be considered in evaluating the 14- or 28-day strength of the concrete.

22.2.5.3 Air Content: Two tests for air content shall be made on randomly selected batches of concrete for each 500 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. The average of each set of two tests shall be plotted on a control chart on which the average is set at 6 percent in regions where resistance to freezing and thawing is considered and the upper and lower control limits at 7 and 5 percent, respectively. The range shall be plotted on a control chart on which the upper control limit is 2 percent.

22.2.5.4 Slump: Two slump tests shall be made on randomly selected batches of each class of concrete for each 500 cubic yards, or fraction thereof, of concrete placed during each shift production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. The average of each set of two tests shall be plotted on a control chart on which the average is that stipulated by the Contracting Officer and the upper and lower limits are set 1 inch above and below the

average. The range shall be plotted on a control chart on which the upper control limit is 2 inches.

22.2.6 Placing: The placing foremen shall supervise all placing operations, shall determine that the correct class of concrete is placed in each location as directed by the Contracting Officer, and shall be responsible for measuring and recording concrete temperatures, ambient temperature, weather conditions, time of placement, yardage placed, and method and location of placement.

22.2.7 Curing: No curing compound shall be applied until the Contractor has verified that the compound is properly mixed and ready for spraying. At the end of each operation, the Contractor shall determine the quantity of compound used, as well as the area of concrete surface covered, and compute the rate of coverage in square feet per gallon, noting whether coverage is uniform.

22.2.8 Cold-Weather Placing: At least once during each shift an inspection shall be made of all areas subject to cold-weather protection. Deficiencies shall be noted. During removal of protection, the concrete and ambient temperature shall be measured at least hourly.

22.2.9 Hot-Weather Placing: The Contractor shall take and record the temperature of the concrete mixture at 30-minute intervals during hot-weather placement. The forms and underlying material shall be inspected to assure that they are sprinkled with water immediately before the concrete is placed and any deficiencies noted. The finished concrete shall be inspected to assure that it is kept damp until the curing medium is applied and any deficiencies noted.

22.2.10 Finished Concrete Surface: The Contractor shall perform the testing required to insure that the finished surface conforms to the plan grade, surface smoothness, and edge slump.

## 22.3 Action Required:

### 22.3.1 Fine Aggregate:

22.3.1.1 Grading: When the amount retained on any sieve is outside the specification limits, the fine aggregate shall be resampled and retested. If there is another failure on the same sieve, the fact shall be reported immediately to the Contracting Officer. All such tests shall be included in the control charts. Whenever a point, either for the average or the range, is beyond one of the control limits, the frequency of testing shall be doubled. If two consecutive points are beyond the control limits, the process shall be considered out of control. The Contracting Officer shall be notified, and immediate steps shall be taken to rectify the situation. After two consecutive points have fallen within the control limits, testing at the normal frequency may be resumed.

22.3.1.2 Moisture Content: Whenever the moisture content of the fine aggregate changes by 0.5 percent or more, the scale settings for the fine aggregate batcher and water batcher shall be adjusted (directly or by means of a moisture compensation device). If, at any time, the requirements for moisture variation are not met, the Contracting Officer shall be notified and immediate steps shall be taken to reduce the variation.

### 22.3.2 Coarse Aggregate:

22.3.2.1 Grading: When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be resampled and retested. If the second sample fails on the same sieve, that fact shall be reported to the Contracting Officer. When two consecutive averages of five tests (or two consecutive tests where large samples are used) are outside of the specification limits, that fact shall be reported to the Contracting Officer and immediate steps shall be taken to correct the grading.

22.3.2.2 Moisture: Whenever the moisture content of the smallest size of coarse aggregate changes by 0.5 percent or more, the scale settings for the aggregate batcher and water batcher shall be adjusted (directly or by means of a moisture compensation device). If, at any time, the requirements for moisture variation are not met, the Contracting Officer shall be notified and immediate steps taken to reduce the variation.

22.3.2.3 Particle Shape: When testing for particle shape is required, two consecutive failures in the same sieve size shall be reported immediately to the Contracting Officer, who shall provide instructions as to the necessity for corrective action.

22.3.3 Scales: Whenever either the weighing or the batching accuracy is found not to comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected immediately.

#### 22.3.4 Concrete:

22.3.4.1 Strength: The results of the 14-day strength test shall be plotted on a control chart; when more than 20 percent of the consecutive individual tests are less than the specified value or the average of any five consecutive tests is less than the specified value, the Contracting Officer shall be notified and the mixture proportions changed to increase the strength of the mixture. When the average of any five consecutive 28-day-age tests is less than the specified strength, care shall be taken to define the area of low-strength pavement and the area removed and replaced in accordance with requirements of paragraph REMOVAL AND REPLACEMENT OF DEFECTIVE CONCRETE.

22.3.4.2 Air Content: Whenever points on the control chart approach the upper or lower control limits, an adjustment should be made in the amount of the air-entraining admixture batched. If a single test result is outside the specification limit, such an adjustment is mandatory. As soon as practicable after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever a point falls above the upper control limit for the range, the dispenser shall be calibrated to insure that it is operating correctly and with good reproducibility. Whenever two consecutive points, either for the average or the range, are outside the control limits, the Contracting Officer shall be notified.

22.3.4.3 Slump: Whenever points on the control chart approach the upper or lower control limits, an adjustment should be made in the batch weight of water and fine aggregate. When a single slump is outside the control limits, such an adjustment is mandatory. As soon as practicable after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever the slump departs more than 1-1/2 inches from that stipulated by the Contracting Officer, the concrete shall not be delivered to the paver. Whenever two consecutive slump tests that were made during a period when there was no adjustment of batch weights produce a point on the control chart for a range above the upper control limit, the slump shall be considered out of control and the additional testing for aggregate moisture content required above shall be undertaken.

22.3.5 Curing: When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.

22.3.6 Cold-Weather Protection: The Contracting Officer shall be notified whenever the concrete temperature during the period of protection or protection removal fails to comply with the specifications, and immediate steps shall be taken to correct the situation.

22.3.7 Hot-Weather Placing: When the temperature of the concrete mixture exceeds 90 degrees F, mixing and placing shall be terminated and the Contracting Officer notified.

22.3.8 Mixer Performance: At the start of concrete placing, and at least once every 3 months when concrete is being placed, the uniformity of concrete shall be determined. The initial and every fourth test shall be performed in accordance with the regular test of CRD-C 55. Other tests shall be performed in accordance with abbreviated tests of CRD-C 55. Whenever adjustments in the mixer or increases in mixing times are necessary because of failure of any mixer to comply, the mixer shall be retested after adjustments. For complete testing, three different batches of concrete shall be tested. For abbreviated tests, one batch shall be tested. Results of tests shall be reported in writing.

22.4 Reports: All results of tests conducted at the project site shall be reported weekly and shall be delivered to a designated representative of the Contracting Officer within 3 days after the end of each weekly reporting period. Each weekly report shall include the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failure and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all Contractor quality control records.

23. CLEAN-UP: After completion of the protection and curing period, insulating and curing materials shall be removed and disposed of off the site. Concrete surfaces shall be swept and washed free of stains, discolorations, and loose particles.

--End of Section --



## SECTION C-02760

### FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in this text by the basic designation only.

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509	(1994) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM D 789	(1994) Determination of Relative Viscosity, Melting Point, and Moisture Content of Polyamide (PA)
ASTM D 3405	(1994) Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements
ASTM D 3569	(1985; R 1991) Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant-Type for Portland Cement Concrete Pavements
ASTM D 5893	(1996) Cold Applied, Single Component Chemically Curing Silicon Joint Sealant for Portland Cement Concrete Pavement

#### CORPS OF ENGINEERS (COE)

COE CRD-C 525	(1989) Corps of Engineers Test Method for Evaluation of Hot-Applied Joint Sealants for Bubbling Due to Heating
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##### 1.2 NOT USED

##### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

#### SD-06 Instructions

Manufacturer's Recommendations; GA.

Where installation procedures, or any part thereof, are required to be in accordance with the manufacturer's recommendations, printed copies of these recommendations, 30 days prior to use on the project. Installation of the material will not be allowed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

#### SD-07 Schedules

Construction Equipment List; FIO.

List of proposed equipment to be used in performance of construction work including descriptive data, 30 days prior to use on the project.

## SD-13 Certifications

Materials; FIO.

Submit certified copies of test reports per PARAGRAPH 1.5.

## SD-14 Samples

Materials; GA.

Samples of the materials (sealant, primer if required, and backup material), in sufficient quantity for testing 30 days prior to the beginning of work. No material will be allowed to be used until it has been approved.

### 1.4 NOT USED

### 1.5 TEST REQUIREMENTS

The joint sealant and backup or separating material shall be tested for conformance with the referenced applicable material specification and COE CRD-C 525. Testing of the materials shall be performed in an approved independent laboratory and certified copies of the test reports shall be submitted and approved 30 days prior to the use of the materials at the job site. Samples will be retained by the Government for possible future testing should the materials appear defective during or after application. Conformance with the requirements of the laboratory tests specified will not constitute final acceptance of the materials. Final acceptance will be based on the performance of the in-place materials.

### 1.6 EQUIPMENT

Machines, tools, and equipment used in the performance of the work required by this section shall be reviewed before the work is started and shall be maintained in satisfactory condition at all times.

#### 1.6.1 Joint Cleaning Equipment

##### 1.6.1.1 Tractor-Mounted Routing Tool

The routing tool used for removing old sealant from the joints shall be of such shape and dimensions and so mounted on the tractor that it will not damage the sides of the joints. The tool shall be designed so that it can be adjusted to remove the old material to varying depths as required. The use of V-shaped tools or rotary impact routing devices will not be permitted. Hand-operated spindle routing devices may be used to clean and enlarge random cracks.

##### 1.6.1.2 Concrete Saw

A self-propelled power saw with water-cooled diamond or abrasive saw blades will be provided for cutting joints to the depths and widths specified or for refacing joints or cleaning sawed joints where sandblasting does not provide a clean joint.

##### 1.6.1.3 Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hose, and long-wearing venturi-type nozzle of proper size, shape and opening. The maximum nozzle opening should not exceed 1/4 inch. The air compressor shall be portable and shall be capable of furnishing not less than 150 cubic feet per minute and maintaining a line pressure of not less than 90 psi at the nozzle while in use. Compressor capability under job conditions must be demonstrated before approval. The compressor shall be equipped with traps that will maintain the compressed air

free of oil and water. The nozzle shall have an adjustable guide that will hold the nozzle aligned with the joint approximately 1 inch above the pavement surface. The height, angle of inclination and the size of the nozzle shall be adjusted as necessary to secure satisfactory results.

#### 1.6.1.4 Waterblasting Equipment

Waterblasting equipment shall include a trailer-mounted water tank, pumps, high-pressure hose, wand with safety release cutoff control, nozzle, and auxiliary water resupply equipment. The water tank and auxiliary resupply equipment shall be of sufficient capacity to permit continuous operations. The nozzle shall have an adjustable guide that will hold the nozzle aligned with the joint approximately 1 inch above the pavement surface. The height, angle of inclination and the size of the nozzle shall be adjustable as necessary to obtain satisfactory results. A pressure gauge mounted at the pump shall show at all times the pressure in pounds per square inch at which the equipment is operating.

#### 1.6.2 Sealing Equipment

##### 1.6.2.1 Hot-Poured Sealing Equipment

The unit applicators used for heating and installing ASTM D 3405 or ASTM D 3569 joint sealant materials shall be mobile and shall be equipped with a double-boiler, agitator-type kettle with an oil medium in the outer space for heat transfer; a direct-connected pressure-type extruding device with a nozzle shaped for inserting in the joint to be filled; positive temperature devices for controlling the temperature of the transfer oil and sealant; and a recording type thermometer for indicating the temperature of the sealant. The applicator unit shall be designed so that the sealant will circulate through the delivery hose and return to the inner kettle when not in use.

##### 1.6.2.2 NOT USED

##### 1.6.2.3 NOT USED

##### 1.6.2.4 NOT USED

#### 1.7 TRIAL JOINT SEALANT INSTALLATION

Prior to the cleaning and sealing of the joints for the entire project, a test section of at least 200 feet long shall be prepared using the specified materials and approved equipment, so as to demonstrate the proposed joint preparation and sealing of all types of joints in the project. Following the completion of the test section and before any other joint is sealed, the test section shall be inspected to determine that the materials and installation meet the requirements specified. If it is determined that the materials or installation do not meet the requirements, the materials shall be removed, and the joints shall be recleaned and resealed at no cost to the Government. When the test section meets the requirements, it may be incorporated into the permanent work. All other joints shall be prepared and sealed in the manner approved for sealing the test section.

#### 1.8 DELIVERY AND STORAGE

Materials delivered to the job site shall be inspected for defects, unloaded, and stored with a minimum of handling to avoid damage. Storage facilities shall be provided by the Contractor at the job site for maintaining materials at the temperatures and conditions recommended by the manufacturer.

#### 1.9 ENVIRONMENTAL CONDITIONS

The ambient air temperature and the pavement temperature within the joint wall shall be a minimum of 50 degrees F and rising at the time of application of the materials. Sealant shall not be applied if moisture is observed in the joint.

## PART 2 PRODUCTS

### 2.1 SEALANTS

Materials for sealing cracks in the various paved areas indicated on the drawings shall be as follows:

<u>Area</u>	<u>Sealing Material</u>
Bituminous Concrete Areas (if Required)	ASTM D 3405 and COE CRD-C 525
Portland Cement Concrete Hardstand	ASTM D 3569 and COE CRD-C 525

### 2.2 PRIMERS

Primers, when their use is recommended by the manufacturer of the sealant, shall be as recommended by the manufacturer of the sealant.

### 2.3 BACKUP MATERIALS

The backup material shall be a compressible, nonshrinking, nonstaining, nonabsorbing material and shall be nonreactive with the joint sealant. The material shall have a melting point at least 5 degrees F greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D 789. The material shall have a water absorption of not more than 5 percent of the sample weight when tested in accordance with ASTM C 509. The backup material shall be 25 plus or minus 5 percent larger in diameter than the nominal width of the crack.

### 2.4 BOND BREAKING TAPES

The bond breaking tape or separating material shall be a flexible, nonshrinkable, nonabsorbing, nonstaining, and nonreacting adhesive-backed tape. The material shall have a melting point at least 5 degrees F greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D 789. The bond breaker tape shall be approximately 1/8-inch wider than the nominal width of the joint and shall not bond to the joint sealant.

## PART 3 EXECUTION

### 3.1 PREPARATION OF JOINTS

Immediately before the installation of the sealant, the joints shall be thoroughly cleaned to remove all laitance, curing compound, filler, protrusions of hardened concrete, and old sealant from the sides and upper edges of the joint space to be sealed.

#### 3.1.1 NOT USED

#### 3.1.2 Sawing

##### 3.1.2.1 Facing of Joints

Facing of joints shall be accomplished using a concrete saw as specified in paragraph EQUIPMENT to saw through sawed and filler-type joints to loosen and remove material until the joint is clean and open to the full specified width and depth. The blade shall be stiffened with a sufficient number of suitable dummy (used) blades or washers. Immediately following the sawing operation, the joint opening shall be thoroughly cleaned using a water jet to remove all saw cuttings

and debris. If "dry" sawing is used to face the joints, debris may be removed using compressed air.

#### 3.1.2.2 NOT USED

#### 3.1.3 Sandblasting

The newly exposed concrete joint faces and the pavement surfaces extending a minimum of 1/2 inch from the joint edges shall be sandblasted or waterblasted clean. A multiple-pass technique shall be used until the surfaces are free of dust, dirt, curing compound, filler, old sealant residue, or any foreign debris that might prevent the bonding of the sealant to the concrete. After final cleaning and immediately prior to sealing, the joints shall be blown out with compressed air and left completely free of debris and water.

#### 3.1.4 Back-Up Material

When the joint opening is of a greater depth than indicated for the sealant depth, the lower portion of the joint opening shall be plugged or sealed off using a back-up material to prevent the entrance of the sealant below the specified depth. Care shall be taken to ensure that the backup material is placed at the specified depth and is not stretched or twisted during installation.

#### 3.1.5 Bond Breaking Tape

Where inserts or filler materials contain bitumen, or the depth of the joint opening does not allow for the use of a backup material, a bond breaker separating tape will be inserted to prevent incompatibility with the filler materials and three-sided adhesion of the sealant. The tape shall be securely bonded to the bottom of the joint opening so it will not float up into the new sealant.

#### 3.1.6 Rate of Progress of Joint Preparation

The stages of joint preparation which include sandblasting, air pressure cleaning and placing of the back-up material shall be limited to only that lineal footage that can be sealed during the same day.

### 3.2 PREPARATION OF SEALANT

#### 3.2.1 Hot-Poured Sealants

Sealants conforming to ASTM D 3405 and ASTM D 3569 shall not be heated in excess of the safe heating temperature recommended by the manufacturer as shown on the sealant containers. Sealant that has been overheated or subjected to application temperatures for over 4 hours or that has remained in the applicator at the end of the day's operation shall be withdrawn and wasted.

#### 3.2.2 NOT USED

#### 3.2.3 NOT USED

#### 3.2.4 NOT USED

### 3.3 INSTALLATION OF SEALANT

#### 3.3.1 Time of Application

Joints shall be sealed immediately following final cleaning of the joint walls and following the placement of the separating or backup material. Open joints that cannot be sealed under the conditions specified, or when rain interrupts

sealing operations shall be recleaned and allowed to dry prior to installing the sealant.

### 3.3.2 Sealing Joints

Immediately preceding, but not more than 50 feet ahead of the joint sealing operations, a final cleaning with compressed air shall be performed. The joints shall be filled from the bottom up to 3/16 inch plus or minus 1/16 inch below the pavement surface. Excess or spilled sealant shall be removed from the pavement by approved methods and shall be discarded. The sealant shall be installed in such a manner as to prevent the formation of voids and entrapped air. In no case shall gravity methods or pouring pots be used to install the sealant material. Traffic shall not be permitted over newly sealed pavement until authorized by the Contracting Officer. When a primer is recommended by the manufacturer, it shall be applied evenly to the joint faces in accordance with the manufacturer's instructions. Joints shall be checked frequently to ensure that the newly installed sealant is cured to a tack-free condition within the time specified.

## 3.4 INSPECTION

### 3.4.1 Joint Cleaning

Joints shall be inspected during the cleaning process to correct improper equipment and cleaning techniques that damage the concrete pavement in any manner. Cleaned joints shall be approved prior to installation of the separating or back-up material and joint sealant.

### 3.4.2 Joint Sealant Application Equipment

The application equipment shall be inspected to ensure conformance to temperature requirements, and proper installation. Evidences of bubbling, improper installation, failure to cure or set shall be cause to suspend operations until causes of the deficiencies are determined and corrected.

### 3.4.3 Joint Sealant

The joint sealant shall be inspected for proper rate of cure and set, bonding to the joint walls, cohesive separation within the sealant, reversion to liquid, entrapped air and voids. Sealants exhibiting any of these deficiencies at any time prior to the final acceptance of the project shall be removed from the joint, wasted, and replaced as specified herein at no additional cost to the Government.

## 3.5 CLEAN-UP

Upon completion of the project, all unused materials shall be removed from the site and the pavement shall be left in a clean condition.

-- End of Section --

SECTION C-02831

CHAIN LINK FENCE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 94 (1996) Ready-Mixed Concrete

ASTM F 883 (1990) Padlocks

AMERICAN WELDING SOCIETY (AWS)

AWS WZC (1972) Welding Zinc-Coated Steels

FEDERAL SPECIFICATIONS (FS)

FS RR-F-191/GEN (Rev K) Fencing, Wire and Post Metal (and Gates, Chain-Link Fence Fabric, and Accessories)

FS RR-F-191/1 (Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Fabric)

FS RR-F-191/2 (Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Gates)

FS RR-F-191/3 (Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces)

FS RR-F-191/4 (Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Accessories)

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Chain Link Fence; FIO.

Drawings showing post sizes and sections; post setting and bracing; gate details; barbed wire support arms; details of attachment of fabric and barbed wire to support members; and any other details required to erect the fence along the lines indicated.

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall conform to the following:

#### 2.1.1 Chain Link Fence

FS RR-F-191/GEN.

##### 2.1.1.1 Fabric

FS RR-F-191/1, Type I, zinc-coated steel wire with minimum coating weight of 1.2 ounces) of zinc per square foot of coated surface, or Type II, aluminum-coated steel wire. Fabric shall be fabricated of 9-gauge wire woven in 2-inch mesh. Fabric height shall be 7 feet as shown. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage.

##### 2.1.1.2 Gates

FS RR-F-191/2. Gate shall be the type and swing shown. Gate frames shall be constructed of Class 1 Grade A or B, steel pipe, size SP2, as specified in FS RR-F-191/3. Gate fabric shall be as specified for chain-link fabric. Each end member of gate frames shall be extended sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence. Gate leaves more than 8 feet wide shall have either intermediate members and diagonal truss rods or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted. Latches, hinges, stops, keepers, rollers, and other hardware items shall be furnished as required for the operation of the gate. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate. Stops shall be provided for holding the gates in the open position.

##### 2.1.1.3 Posts

FS RR-F-191/3, zinc-coated; Class 1 Grade A or B, steel pipe; Class 3, formed steel sections; or Class 6, steel square sections. Class 4, steel H-section may be used for line posts in lieu of line post shapes specified for the other classes. Sizes shall be as shown on the drawings. Line posts and terminal (corner, gate, and pull) posts selected shall be of the same class throughout the fence. Gate post shall be either round or square, subject to the limitation specified in FS RR-F-191/3.

##### 2.1.1.4 Braces and Rails

FS RR-F-191/3, zinc-coated, Class 1, Grade A or B, steel pipe, size SP1. Class 3, formed steel sections, size FS1, conforming to FS RR-F-191/3, may be used as braces and rails if Class 3 line posts are furnished.

##### 2.1.1.5 Accessories

FS RR-F-191/4. Ferrous accessories shall be zinc or aluminum coated. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment. Barbed wire shall be zinc or aluminum coated, 4 point barbed type, steel wire. Barbed wire support arms shall be the single arm type and of the design required for the post furnished. Tie wire for attaching fabric to rails, braces, and posts shall be 9-gauge steel wire.

##### 2.1.1.6 NOT USED

#### 2.1.2 Concrete



ASTM C 94, using 3/4-inch maximum size aggregate, and having minimum compressive strength of 3000 psi at 28 days. Grout shall consist of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

2.1.1.3 THRU 2.1.1.8 NOT USED

2.1.1.9 Padlocks

ASTM F 883, Type P01, Grade 2, Size 1-3/4 inch. Padlocks shall be keyed alike and each lock shall be furnished with two keys.

2.1.1.10 NOT USED

2.1.1.11 NOT USED

### PART 3 EXECUTION

#### 3.1 GENERAL

Fence shall be installed to the lines and grades indicated. The area on either side of the fence line shall be cleared to the extent indicated. Line posts shall be spaced equidistant at intervals not exceeding 10 feet. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 500 feet. Damage to the galvanized surface due to welding shall be repaired with "repair sticks" of zinc-cadmium alloys or zinc-tin-lead alloys per AWS WZC.

#### 3.2 EXCAVATION

Post holes shall be cleared of loose material. Waste material shall be spread where directed.

#### 3.3 POSTS

Posts shall be set plumb and in alignment. Except where solid rock is encountered, posts shall be set in concrete to the depth indicated on the drawings. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of 18 inches in rock. Where solid rock is covered with an overburden of soil or loose rock, posts shall be set to the minimum depth indicated on the drawing unless a penetration of 18 inches in solid rock is achieved before reaching the indicated depth, in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted. Portions of posts not set in rock shall be set in concrete from the rock to ground level. Posts set in concrete shall be set in holes not less than the diameter shown on the drawings. Diameters of holes in solid rock shall be at least 1 inch greater than the largest cross section of the post. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts. Fence post rigidity shall be tested by applying a 50-pound force on the post, perpendicular to the fabric, at 5 feet above ground. Post movement measured at the point where the force is applied shall be less than or equal to 3/4 inch from the relaxed position. Every tenth post shall be tested for rigidity. When a post fails this test, further tests on the next four posts on either side of the failed post shall be made. All failed posts shall be removed, replaced, and retested at the Contractor's expense.

#### 3.4 RAILS

##### 3.4.1 Top Rail

Top rail shall be supported at each post to form a continuous brace between terminal posts. Where required, sections of top rail shall be joined using sleeves or couplings that will allow expansion or contraction of the rail.

#### 3.4.2 NOT USED

#### 3.5 BRACES AND TRUSS RODS

Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Horizontal (compression) braces and diagonal truss (tension) rods shall be installed on fences over 6 feet in height. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal. No bracing is required on fences 6 feet high or less if a top rail is installed.

#### 3.6 TENSION WIRES

Tension wires shall be installed along the bottom of the fence line and attached to the terminal posts of each stretch of the fence. Bottom tension wire shall be installed within the bottom 6 inches of the installed fabric. Tension wire shall be pulled taut and shall be free of sag.

#### 3.7 CHAIN LINK FABRIC

Chain link fabric shall be installed on the side of the post indicated. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately 15-inch intervals. The fabric shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately 15-inch intervals and fastened to all rails and tension wires at approximately 12-inch intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be 2 inches (plus or minus 1/2-inch) above the ground or concrete hardstand.

#### 3.8 BARBED WIRE SUPPORTING ARMS AND BARBED WIRE

Barbed wire supporting arms and barbed wire shall be installed as indicated and as recommended by the manufacturer. Supporting arms shall be anchored to the posts in a manner to prevent easy removal with hand tools. Barbed wire shall be pulled taut and attached to the arms with clips or other means that will prevent easy removal.

#### 3.9 GATES

Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing 180 degrees. Latches, stops, and keepers shall be installed as required. Slide gates shall be installed as recommended by the manufacturer. Padlocks shall be attached to gates or gate posts with chains and hinge pins, and hardware shall be welded or otherwise secured to prevent removal.

#### 3.10 NOT USED

#### 3.11 GROUNDING

Fences shall be grounded as specified in Section C-16670 LIGHTNING PROTECTION SYSTEM.

-- End of Section --

SECTION C-02935

TURF

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AGRICULTURAL MARKETING SERVICE (AMS)

AMS-01 (Amended thru: Aug 1988) Federal Seed  
Act Regulations (Part 201-202)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2607 (1969) Peats, Mosses, Humus, and Related  
Products

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1909 (Basic; Notice 1) Fertilizer

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-01 Data

Manufacturer's Literature; FIO.

Manufacturer's literature discussing physical characteristics, application and installation instructions for erosion control material, and for chemical treatment material.

SD-08 Statements

Delivery; FIO.

Delivery schedule, at least 10 days prior to the intended date of the first delivery.

SD-09 Reports

Maintenance Report; FIO.

Maintenance report shall be as described in Section 3.10.3.7.

SD-13 Certificates

Certificates of compliance certifying that materials meet the requirements specified, prior to the delivery of materials. Certified copies of the reports for the following materials shall be included:

Seed; FIO.

For mixture, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, date tested and state certification.

Sod; FIO.

For species, mixture percentage, percent purity, field location.

Fertilizer; FIO.

For chemical analysis, composition percent.

Agricultural Limestone; FIO.

For calcium carbonate equivalent and sieve analysis.

Topsoil; FIO.

For pH, particle size, chemical analysis and mechanical analysis.

### 1.3 SOURCE INSPECTIONS

Sod material may be subject to inspection by the Contracting Officer at the growing site.

### 1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

#### 1.4.1 Delivery

##### 1.4.1.1 Protection

Sod shall be protected from drying out and contamination during delivery.

##### 1.4.1.2 Topsoil

A soil test shall be provided for topsoil delivered to the site.

##### 1.4.1.3 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

##### 1.4.1.4 NOT USED

#### 1.4.2 Inspection

Seed and sod shall be inspected upon arrival at the job site by the Contracting Officer for conformity to type and quality in accordance with paragraph MATERIALS. Other materials shall be inspected for meeting specified requirements and unacceptable materials shall be removed from the job site.

#### 1.4.3 Storage

Materials shall be stored in areas designated by the Contracting Officer. Sod shall be lightly sprinkled with water, covered with moist burlap, straw, or other covering and protected from exposure to wind and direct sunlight until planted. Covering for sod shall allow air to circulate and prevent internal heat from building up. Seed, lime and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment materials shall not be stored with other landscape materials.

#### 1.4.4 Handling

##### 1.4.4.1 Materials

Care shall be taken to avoid injury to sod. Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

##### 1.4.4.2 Time Limitation

Sod: Limitation of the time between harvesting and placing of sod shall be 36 hours.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 Seed

##### 2.1.1.1 Seed Classification

State-certified seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS-01 and applicable state seed laws.

##### 2.1.1.2 Seed Mixtures

Seed mixtures shall be proportioned by weight as follows:

Botanical Name	Common Name	Mixture Percent by Weight
Festuca arundinacea	Kentucky 31 Fescue	50
Festuca rubra	Creeping Red Fescue	35
Lolium perenne	Annual Ryegrass	5
Agrostis alba	Red Top	10

##### 2.1.1.3 Quality

Weed seed shall not exceed 1 percent by weight of the total mixture. Wet, moldy, or otherwise damaged seed shall be rejected.

##### 2.1.1.4 NOT USED

##### 2.1.1.5 Temporary Seed

The temporary seed for erosion control shall be as follows:

Botanical Name	Common Name	Mixture Percent by Weight
Lolium perenne	Perennial Ryegrass	88

##### 2.1.1.6 Seed Mixing

The field mixing of seed shall be performed on site in the presence of the Contracting Officer.

#### 2.1.2 Sod

##### 2.1.2.1 Sod Classification

State-certified nursery-grown sod shall be provided as classified by applicable state laws. Each individual sod section shall be of a size to permit rolling and lifting without breaking.

#### 2.1.2.2 Grass Species

Grass species shall be proportioned as follows:

Botanical Name	Common Name	Mixture Percent by Weight
Festuca arundinacea	Tall Fescue	55
Festuca rubra	Fine Fescue	35

#### 2.1.2.3 Quality

The sod shall be relatively free of thatch, diseases, nematodes, soil-borne insects, weeds or undesirable plants, stones larger than 2 inches in any dimension, woody plant roots and other material detrimental to a healthy stand of turf. Sod that has become dry, moldy, or yellow from heating, or has irregularly shaped pieces of sod and torn or uneven ends shall be rejected.

#### 2.1.2.4 Thickness

Sod shall be machine cut to a uniform thickness of 1-1/4 inches within a tolerance of 1/4 inch, excluding top growth and thatch. Measurement for thickness shall exclude top growth and thatch.

#### 2.1.2.5 Anchors

Sod anchors shall be as recommended by the sod supplier.

#### 2.1.3 NOT USED

#### 2.1.4 Soil Amendments

Soil amendments shall consist of lime, fertilizer, organic soil amendments and soil conditioners meeting the following requirements.

##### 2.1.4.1 Lime

Lime shall be agricultural limestone and shall have a minimum calcium carbonate equivalent of 90 percent and shall be ground to such a fineness that at least 90 percent will pass a 10-mesh sieve and at least 50 percent will pass a 60-mesh sieve.

##### 2.1.4.2 Fertilizer

Fertilizer shall be commercial grade, free flowing, uniform in composition and conforming to CID A-A-1909. Granular Fertilizer: As recommended by the soil test.

##### 2.1.4.3 Organic Soil Amendments

Topsoil: The existing surface soil shall be stripped and stockpiled on the site in accordance with Section C-02225 EARTHWORK FOR ROADWAYS, RAILROADS, AND AIRFIELDS. When required beyond that available from stripping, the topsoil shall be delivered. Delivered topsoil shall conform to topsoil requirements specified in Section C-02225 EARTHWORK FOR ROADWAYS, RAILROADS, AND AIRFIELDS, and shall be amended as recommended by soil test.

##### 2.1.4.4 Soil Conditioner

Soil conditioner shall be for single use or in combination to meet requirements for topsoil. Gypsum shall be commercially packaged, free flowing, minimum 95 percent calcium sulfate by volume.

#### 2.1.5 Mulch

Mulch shall be free from weeds, mold, and other deleterious materials.

##### 2.1.5.1 Straw

Straw shall be stalks from oats, wheat, rye, barley, or rice furnished in air-dry condition and with a consistency for placing with commercial mulch-blowing equipment.

##### 2.1.5.2 Hay

Hay shall be native hay, sudan-grass hay, broomsedge hay, or other herbaceous mowings furnished in an air-dry condition suitable for placing with commercial mulch-blowing equipment.

##### 2.1.5.3 Wood Cellulose Fiber

Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate visual metering during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 4.5 to 6.0.

##### 2.1.5.4 NOT USED

##### 2.1.5.5 Paper Fiber Mulch

Paper fiber mulch shall be recycled news print that is shredded for the purpose of mulching seed.

##### 2.1.6 NOT USED

##### 2.1.7 Water

Water shall not contain elements toxic to plant life.

##### 2.1.8 NOT USED

##### 2.1.9 Erosion Control Material

Soil erosion control shall conform to the following:

###### 2.1.9.1 Soil Erosion Control Blanket

Machine produced mat of wood excelsior formed from a web of interlocking wood fibers, covered on one side with either knitted straw blanket-like mat construction, covered with biodegradable plastic mesh, or interwoven biodegradable thread, plastic netting or twisted kraft paper cord netting.

###### 2.1.9.2 Soil Erosion Control Fabric

Knitted construction of polypropylene yarn with uniform mesh openings 3/4 to 1 inch square with strips of biodegradable paper. Filler paper strips shall last 6 to 8 months.

###### 2.1.9.3 Soil Erosion Control Net

Heavy, twisted jute mesh weighing approximately 1.22 pounds per linear yard and 4 feet wide with mesh openings of approximately 1 inch square.

2.1.9.4 NOT USED

2.1.9.5 NOT USED

2.1.9.6 Anchors

Erosion control anchor material shall be as recommended by the manufacturer.

### PART 3 EXECUTION

#### 3.1 SEEDING AND SODDING TIMES AND CONDITIONS

##### 3.1.1 Seeding Time

Seed shall be sown from 15 March to 15 June for spring planting and from 15 September to 15 November for fall planting.

##### 3.1.2 Sodding Time

Sod may be placed at any time when the ground is not frozen.

##### 3.1.3 NOT USED

##### 3.1.4 Turfing Conditions

Turf operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the turf operations, proposed times shall be submitted to and approved by the Contracting Officer.

#### 3.2 SITE PREPARATION

##### 3.2.1 Grading

The Contracting Officer shall verify that finished grades are as indicated on drawings, and the placing of topsoil and the smooth grading has been completed in accordance with Section C-02225 EARTHWORK FOR ROADWAYS, RAILROADS, AND AIRFIELDS.

##### 3.2.2 Application of Soil Amendments

###### 3.2.2.1 Soil Test

A soil test shall be performed for pH, chemical analysis and mechanical analysis to establish the quantities and type of soil amendments required to meet local growing conditions for the type and variety of turf specified.

###### 3.2.2.2 Lime

Lime shall be applied at the rate recommended by the soil test. Lime shall be incorporated into the soil to a minimum depth of 4 inches or may be incorporated as part of the tillage operation.

###### 3.2.2.3 Fertilizer

Fertilizer shall be applied at the rate recommended by the soil test. Fertilizer shall be incorporated into the soil to a minimum depth of 4 inches and may be incorporated as part of the tillage or hydroseeding operation.



#### 3.2.2.4 Soil Conditioner

Soil Conditioner shall be spread uniformly over the soil to a minimum depth of 2 inches and thoroughly incorporated by tillage into the soil to a minimum depth of 4 inches.

#### 3.2.3 Tillage

##### 3.2.3.1 Minimum Depth

Soil on slopes gentler than 3-horizontal-to-1-vertical shall be tilled to a minimum depth of 4 inches. On slopes between 3-horizontal-to-1-vertical and 1-horizontal-to-1 vertical, the soil shall be tilled to a minimum depth of 2 inches by scarifying with heavy rakes, or other method. Rototillers shall be used where soil conditions and length of slope permit. On slopes 1-horizontal-to-1 vertical and steeper, no tillage is required.

#### 3.2.4 Finished Grading

##### 3.2.4.1 Preparation

Turf areas shall be filled as needed or have surplus soil removed to attain the finished grade. Drainage patterns shall be maintained as indicated on drawings. Turf areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of erosion or grade deficiencies shall conform to topsoil requirements specified in Section C-02225 EARTHWORK FOR ROADWAYS, RAILROADS, AND AIRFIELDS. Finished grade shall be 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas.

##### 3.2.4.2 Lawn Area Debris

Lawn areas shall have debris and stones larger than 1 inch in any dimension removed from the surface.

##### 3.2.4.3 Field Area Debris

Field areas shall have debris and stones larger than 3 inches in any dimension removed from the surface.

##### 3.2.4.4 Protection

Finished graded areas shall be protected from damage by vehicular or pedestrian traffic and erosion.

### 3.3 SEEDING

#### 3.3.1 General

Prior to seeding, any previously prepared seedbed areas compacted or damaged by interim rain, traffic or other cause, shall be reworked to restore the ground condition previously specified. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

#### 3.3.2 Equipment Calibration

The equipment to be used and the methods of turfing shall be subject to the inspection and approval of the Contracting Officer prior to commencement of turfing operations. Immediately prior to the commencement of turfing operations, the Contractor shall conduct turfing equipment calibration tests in the presence of the Contracting Officer.

#### 3.3.3 Applying Seed

#### 3.3.3.1 Broadcast Seeding

Seed shall be uniformly broadcast at the rate of 6-8 pounds per 1000 square feet using broadcast seeders. Half of seed shall be broadcast in one direction, and the remainder at right angles to the first direction. Seed shall be covered to an average depth of 1/4 inch by disk harrow, steel mat drag, cultipacker, or other approved device.

#### 3.3.3.2 NOT USED

#### 3.3.3.3 Rolling

Immediately after seeding, except for slopes 3-horizontal-to-1 vertical and greater, the entire area shall be firmed with a roller not exceeding 90 pounds for each foot of roller width.

#### 3.3.4 Hydroseeding

Seed and fertilizer shall be added to water and thoroughly mixed at the rates specified. Wood cellulose fiber mulch shall be added at the rates recommended by the manufacturer after the seed, fertilizer and water have been thoroughly mixed, to produce a homogeneous slurry. Slurry shall be uniformly applied under pressure over the entire area. The hydroseeded area shall not be rolled.

#### 3.3.5 Mulch

##### 3.3.5.1 Straw or Hay Mulch

Straw or hay mulch shall be spread uniformly at the rate of 2 tons per acre. Mulch shall be spread by hand, blower-type mulch spreader or other approved method. Mulching shall be started on the windward side of relatively flat areas or on the upper part of a steep slope and continued uniformly until the area is covered. The mulch shall not be bunched. All seeded areas shall be mulched on the same day as the seeding.

##### 3.3.5.2 Mechanically Anchoring

Immediately following spreading, the mulch shall be anchored to the soil by a V-type-wheel land packer, a scalloped-disk land packer designed to force mulch into the soil surface, or other suitable equipment.

##### 3.3.5.3 NOT USED

##### 3.3.5.4 NOT USED

##### 3.3.5.5 NOT USED

##### 3.3.5.6 Wood Cellulose Fiber

Wood cellulose fiber mulch for use with the hydraulic application of seed and fertilizer shall be applied as part of the hydroseeding operation.

#### 3.3.6 Water

Watering shall be started within 7 days after completing the seeded area. Water shall be applied at a rate sufficient to ensure moist soil conditions to a minimum depth of 1 inch. Run-off and puddling shall be prevented.

### 3.4 SODDING

#### 3.4.1 General

Areas shall be sodded as indicated. Adequate soil moisture shall be ensured prior to sodding by spraying water on the area to be sodded and wetting the soil to a minimum depth of 1 inch.

#### 3.4.2 Placing Sod

Rows of sod shall be placed parallel to and tightly against each other. Joints shall be staggered laterally. The sod strips shall not be stretched or overlapped. All joints shall be butted tight. Voids and air drying of roots shall be prevented. On long slopes, sod shall be laid at right angles to slopes. In ditches, sod shall be laid at right angles to the flow of water. When required, the sod shall be anchored by placing anchors a minimum distance of 2 feet on center with a minimum of 2 anchors per sod section.

#### 3.4.3 Finishing

Air pockets shall be eliminated and a true and even surface shall be provided by tamping or rolling the sod in place. Displacement of the sod shall be assured by knitting of sod to the soil. Frayed edges shall be trimmed and holes or missing corners shall be patched in the sod.

#### 3.4.4 Watering Sod

Watering shall be started immediately after completing each day of sodding. Water shall be applied at a rate sufficient to ensure moist soil conditions to a minimum depth of 1 inch. Run-off and puddling shall be prevented.

#### 3.5 NOT USED

#### 3.6 EROSION CONTROL

##### 3.6.1 Erosion Control Material

Erosion control material, where indicated or required, shall be installed in accordance with manufacturer's instructions. Placement of the erosion control material shall be accomplished without damage to installed material or without deviation to finished grade.

##### 3.6.2 Temporary Turf Cover

###### 3.6.2.1 General

When there are contract delays in the turfing operation or a quick cover is required to prevent erosion, the areas designated for turf shall be seeded with a temporary seed as directed by the Contracting Officer.

###### 3.6.2.2 Application

When no other turfing materials have been applied, the quantity of one half of the required soil amendments shall be applied and the area tilled in accordance with paragraph SITE PREPARATION. Seed shall be uniformly broadcast and applied at the rate of 4 pounds per 1000 square feet. The area shall be watered as required.

#### 3.7 NOT USED

#### 3.8 RESTORATION AND CLEAN UP

##### 3.8.1 Restoration

Existing turf areas, pavements and facilities that have been damaged from the turfing operation shall be restored to original condition at Contractor's expense.

### 3.8.2 Clean Up

Excess and waste material shall be removed from the planting operation and shall be disposed of off the site. Adjacent paved areas shall be cleaned.

## 3.9 PROTECTION OF TURFED AREAS

Immediately after turfing, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed by the Contracting Officer.

## 3.10 TURF ESTABLISHMENT PERIOD

### 3.10.1 Commencement

The Turf Establishment Period for establishing a healthy stand of turf shall begin on the first day of work under this contract and shall end three (3) months after the last day of turfing operations required by this contract. Written calendar time period shall be furnished to the Contracting Officer for the Turf Establishment Period. When there is more than one turf establishment period, describe the boundaries of the turfed area covered for each period.

### 3.10.2 Satisfactory Stand of Turf

#### 3.10.2.1 Seeded Area

a. Lawn Area: A satisfactory stand of turf from the seeding operation for a lawn area is defined as a minimum of 150 grass plants per square foot. Bare spots shall be no larger than 6 inches square. The total bare spots shall not exceed 2 percent of the total seeded area.

b. Field Area: A satisfactory stand of turf from the seeding operation for a field area is defined as a minimum of 75 grass plants per square foot. The total bare spots shall not exceed 2 percent of the total seeded area.

#### 3.10.2.2 Sodded Area

A satisfactory stand of turf from the sodding operation is defined as living sod uniform in color and leaf texture. Bare spots shall be no larger than 2 inches square.

#### 3.10.2.3 NOT USED

### 3.10.3.1 General

Maintenance of the turfed areas shall include eradicating weeds, eradicating insects and diseases, protecting embankments and ditches from erosion, maintaining erosion control materials and mulch, protecting turfed areas from traffic, mowing, watering, and post-fertilization.

#### 3.10.3.2 Mowing

a. Lawn Areas: Lawn areas shall be mowed to a minimum height of 2 inches when the average height of the turf becomes 4 inches. Clippings shall be removed when the amount of cut turf is heavy enough to damage the turfed areas.

b. Field Areas: Field areas shall be mowed once during the season to a minimum height of 4 inches.

#### 3.10.3.3 Watering

Watering shall be at intervals to obtain a moist soil condition to a minimum depth of 1 inch. Frequency of watering and quantity of water shall be adjusted in accordance with the growth of the turf. Run-off, puddling and wilting shall be prevented.

#### 3.10.3.4 Post-Fertilization

Nitrogen carrier fertilizer shall be applied at the rate of 0.5 pounds per 1000 square feet after the first month and again in 3 months. The application shall be timed prior to the advent of winter dormancy and shall avoid excessively high nitrogen levels.

#### 3.10.3.5 NOT USED

#### 3.10.3.6 Repair

The Contractor shall re-establish as specified herein, eroded, damaged or barren areas. Mulch shall also be repaired or replaced as required.

#### 3.10.3.7 Maintenance Report

A written record shall be furnished to the Contracting Officer of the maintenance work performed.

### 3.11 FINAL ACCEPTANCE

#### 3.11.1 Preliminary Inspection

Prior to the completion of the Turf Establishment Period, a preliminary inspection shall be held by the Contracting Officer. Time for the inspection shall be established in writing. The acceptability of the turf in accordance with the Turf Establishment Period shall be determined. An unacceptable stand of turf shall be repaired as soon as turfing conditions permit.

#### 3.11.2 Final Inspection

A final inspection shall be held by the Contracting Officer to determine that deficiencies noted in the preliminary inspection have been corrected. Time for the inspection shall be established in writing.

-- End of Section --

## SECTION C-03100

### STRUCTURAL CONCRETE FORMWORK

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN CONCRETE INSTITUTE (ACI)

ACI 347R (1994) Guide to Formwork for Concrete

##### AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1995) Basic Hardboard

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 578 (1995) Rigid, Cellular Polystyrene Thermal Insulation

##### DEPARTMENT OF COMMERCE (DOC)

DOC PS 1 (1983) Construction and Industrial Plywood

##### 1.2 NOT USED

##### 1.3 DESIGN

Formwork shall be designed in accordance with methodology of ACI 347R for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the class of finish specified in Section 03300 CONCRETE FOR BUILDING CONSTRUCTION. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

##### 1.4 NOT USED

#### PART 2 PRODUCTS

##### 2.1 FORM MATERIALS

###### 2.1.1 Forms For Class B Finish

Forms for Class A and Class B finished surfaces shall be plywood panels conforming to DOC PS 1, Grade B-B concrete form panels, Class I or II. Other form materials or liners may be used provided the smoothness and appearance of concrete produced will be equivalent to that produced by the plywood concrete form panels.

###### 2.1.2 NOT USED

###### 2.1.3 Forms For Class D Finish

Forms for Class D finished surfaces, except where concrete is placed against earth, shall be wood or steel or other approved concrete form material.

###### 2.1.4 Retain-In-Place Metal Forms

Retain-in-place metal forms for concrete slabs and roofs shall be as specified in Section C-05300 STEEL DECKING.

#### 2.1.5 NOT USED

#### 2.1.6 Form Ties

Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal. Solid backing shall be provided for each tie. Except where removable tie rods are used, ties shall not leave holes in the concrete surface less than 1/4 inch nor more than 1 inch deep and not more than 1 inch in diameter. Removable tie rods shall be not more than 1-1/2 inches in diameter.

#### 2.1.7 Form Releasing Agents

Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

#### 2.1.8 NOT USED

#### 2.2 NOT USED

### PART 3 EXECUTION

#### 3.1 INSTALLATION

##### 3.1.1 Formwork

Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section C-03300 CAST-IN-PLACE STRUCTURAL CONCRETE and conforming to construction tolerance given in TABLE 1. Where concrete surfaces are to have a Class B finish, joints in form panels shall be arranged as approved. Where forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface so as to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and of all other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.

##### 3.1.2 NOT USED

##### 3.1.3 NOT USED

#### 3.2 CHAMFERING

Except as otherwise shown, external corners that will be exposed shall be chamfered, beveled, or rounded by moldings placed in the forms.

#### 3.3 COATING

Forms for Class B finished surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions. Forms for Class D finished surfaces may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

Forms shall be removed in a manner that will prevent injury to the concrete and ensure the complete safety of the structure. Formwork for walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement. Supporting forms and shores shall not be removed from beams, floors and walls until the structural units are strong enough to carry their own weight and any other construction or natural loads. In no case will supporting forms or shores be removed before the concrete strength has reached 70 percent of design strengths as determined by field cured cylinders or other approved methods. This strength shall be demonstrated by job-cured test specimens, and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured test specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.

## TOLERANCES FOR FORMED SURFACES

C-03100-3



6. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls	Minus ----- 1/4 inch Plus ----- 1/2 inch
7. Footings:	
a. Variation of dimensions in plan	Minus ----- 1/2 inch Plus ----- 2 inches when formed or plus 3 inches when placed against unformed excavation
b. Misplacement of eccentricity	2 percent of the footing width in the direction of misplacement but not more than ----- 2 inches
c. Reduction in thickness	Minus ----- 5 percent of specified thickness
8. Variation in steps:	Riser ----- 1/8 inch
a. In a flight of stairs	Tread ----- 1/4 inch
b. In consecutive steps	Riser ----- 1/16 inch Tread ----- 1/8 inch
-- End of Section --	

## SECTION C-03200

### CONCRETE REINFORCEMENT

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318/318R (1995) Building Code Requirements for  
Structural Concrete and Commentary

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53 (1996) Pipe, Steel, Black and Hot-Dipped,  
Zinc-Coated Welded and Seamless

ASTM A 82 (1995a) Steel Wire, Plain, for Concrete  
Reinforcement

ASTM A 184 (1996) Fabricated Deformed Steel Bar  
Mats for Concrete Reinforcement

ASTM A 185 (1994) Steel Welded Wire Fabric,  
Plain, for Concrete Reinforcement

ASTM A 497 (1995) Steel Welded Wire Fabric,  
Deformed, for Concrete Reinforcement

ASTM A 615 (1996a) Deformed and Plain  
Billet-Steel Bars for Concrete Reinforcement

ASTM A 675 (1990a; 1995) Steel Bars, Carbon,  
Hot-Wrought, Special Quality, Mechanical  
Properties

ASTM A 706 (1995b) Low-Alloy Steel Deformed Bars  
for Concrete Reinforcement

##### CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI MSP-1 (1990) Manual of Standard Practice

##### 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-04 Drawings

Concrete Reinforcement System; GA.

Detail drawings showing reinforcing steel schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

## SD-13 Certificates

### Reinforcing Steel; FIO.

Certified copies of mill reports attesting that the reinforcing steel furnished meets the requirements specified, prior to the installation of reinforcing steel.

#### 1.3 NOT USED

#### 1.4 DELIVERY AND STORAGE

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

### PART 2 PRODUCTS

#### 2.1 DOWELS

Dowels shall conform to ASTM A 675, Grade 80. Steel pipe conforming to ASTM A 53, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar.

#### 2.2 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A 184.

#### 2.3 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A 615 or ASTM A 706, grades and sizes as indicated.

#### 2.4 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A 185 or ASTM A 497.

#### 2.5 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire.

#### 2.6 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI MSP-1 and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 1/2 inch of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

#### 2.7 NOT USED

### PART 3 EXECUTION

#### 3.1 REINFORCEMENT

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318/318R and ACI 315. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field

or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms.

#### 3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318/318R and ACI 315 at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318/318R. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

#### 3.1.2 Splicing

Splices of reinforcement shall conform to ACI 318/318R and ACI 315 and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6 inches. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

#### 3.2 WELDED-WIRE FABRIC

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet. Fabric shall be positioned by the use of supports.

#### 3.3 DOWELS

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

#### 3.4 NOT USED

-- End of Section --

## SECTION C-03250

### EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO T 111 (1983) Inorganic Matter or Ash in Bituminous Materials

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 919 (1984; R 1992) Standard Practice for Use of Sealants in Acoustical Applications

ASTM C 920 (1994) Elastomeric Joint Sealants

ASTM D 4 (1986; R 1993) Bitumen Content

ASTM D 6 (1980; R 1990) Loss on Heating of Oil and Asphaltic Compounds

ASTM D 1190 (1994) Concrete Joint Sealer, Hot-Poured Elastic Type

ASTM D 1191 (1984; R 1994) Test Methods for Concrete Joint Sealers

ASTM D 1751 (1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction Nonextruding and Resilient Bituminous Types)

ASTM D 1752 (1984; R 1992) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM D 1854 (1974; R 1990) Specification for Jet-Fuel-Resistant Concrete Joint Sealer, Hot-Poured Elastic Type

ASTM D 1855 (1989) Test Method for Jet-Fuel Resistant Concrete Joint Sealer, Hot-Poured Elastic Type

ASTM D 5249 (1992) Backer Material for Use With Cold and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints

#### CORPS OF ENGINEERS (COE)

COE CRD-C 572 (1974) Corps of Engineers Specifications for Polyvinylchloride Waterstops

##### 1.2 NOT USED

##### 1.3 DELIVERY AND STORAGE

Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be

delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

## PART 2 PRODUCTS

### 2.1 NOT USED

### 2.2 PREFORMED EXPANSION JOINT FILLER

Expansion joint filler shall be preformed material conforming to ASTM D 1751 or ASTM D 1752. Unless otherwise indicated, filler material shall be 3/8 inch thick and of a width applicable for the joint formed. Backer material, when required, shall conform to ASTM D 5249.

### 2.3 SEALANT

Joint sealant shall conform to the following:

#### 2.3.1 NOT USED

#### 2.3.2 NOT USED

#### 2.3.3 Hot-Poured Type

ASTM D 1190 tested in accordance with ASTM D 1191.

#### 2.3.4 Field Molded Type

ASTM C 920, Type M for horizontal joints or Type NS for vertical joints, Class 25, and Use NT. Bond breaker material shall be polyethylene tape, coated paper, metal foil or similar type materials. The back-up material shall be compressible, non-shrink, nonreactive with sealant, and non-absorptive material type such as extruded butyl or polychloroprene rubber.

#### 2.3.5 Hot-Applied Jet-Fuel Resistant Type

ASTM D 1854 tested in accordance with ASTM D 1855.

### 2.4 WATERSTOPS

Intersection and change of direction waterstops shall be shop fabricated.

#### 2.4.1 NOT USED

#### 2.4.2 NOT USED

#### 2.4.3 Non-Metallic

Non-metallic waterstops shall be manufactured from a prime virgin resin; reclaimed material is not acceptable. The compound shall contain plasticizers, stabilizers, and other additives to meet specified requirements. Polyvinylchloride waterstops shall conform to COE CRD-C 572.

#### 2.4.4 NOT USED

#### 2.4.5 NOT USED

## PART 3 EXECUTION

### 3.1 JOINTS

Joints shall be installed at locations indicated and as authorized.

### 3.1.1 Contraction Joints

Contraction joints shall be constructed by cutting the concrete with a saw after concrete has set. Joints shall be approximately 1/8 inch wide and shall extend into the slab one-fourth the slab thickness, minimum, but not less than 1 inch.

#### 3.1.1.1 NOT USED

#### 3.1.1.2 Sawed Joints

Joint sawing shall be early enough to prevent uncontrolled cracking in the slab, but late enough that this can be accomplished without appreciable spalling. Concrete sawing machines shall be adequate in number and power, and with sufficient replacement blades to complete the sawing at the required rate. Joints shall be cut to true alignment and shall be cut in sequence of concrete placement. Sludge and cutting debris shall be removed.

### 3.1.2 Expansion Joints

Preformed expansion joint filler shall be used in expansion and isolation joints in slabs around columns and between slabs on grade and vertical surfaces where indicated. The filler shall extend the full slab depth, unless otherwise indicated. The edges of the joint shall be neatly finished with an edging tool of 1/8 inch radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed and oiled wood strip temporarily secured to the top thereof to form a recess to the size shown on the drawings. The wood strip shall be removed after the concrete has set. Contractor may opt to use a removable expansion filler cap designed and fabricated for this purpose in lieu of the wood strip. The groove shall be thoroughly cleaned of laitance, curing compound, foreign materials, protrusions of hardened concrete, and any dust which shall be blown out of the groove with oil-free compressed air.

### 3.1.3 Joint Sealant

Sawed contraction joints and expansion joints in slabs shall be filled with joint sealant, unless otherwise shown. Joint surfaces shall be clean, dry, and free of oil or other foreign material which would adversely affect the bond between sealant and concrete. Joint sealant shall be applied as recommended by the manufacturer of the sealant.

#### 3.1.3.1 NOT USED

#### 3.1.3.2 Joints With Field-Molded Sealant

Joints shall not be sealed when the sealant material, ambient air, or concrete temperature is less than 40 degrees F. When the sealants are meant to reduce the sound transmission characteristics of interior walls, ceilings, and floors the guidance provided in ASTM C 919 shall be followed. Joints requiring a bond breaker shall be coated with curing compound or with bituminous paint. Bond breaker and back-up material shall be installed where required. Joints shall be primed and filled flush with joint sealant in accordance with the manufacturer's recommendations.

## 3.2 WATERSTOPS, INSTALLATION AND SPLICES

Waterstops shall be installed at the locations shown to form a continuous water-tight diaphragm. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any waterstop punctured or damaged shall be repaired or replaced. Exposed

waterstops shall be protected during application of form release agents to avoid being coated. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued. Splices shall be made by certified trained personnel using approved equipment and procedures.

3.2.1 NOT USED

3.2.2 NOT USED

3.2.3 NOT USED

3.2.3.1 NOT USED

3.2.3.2 Polyvinyl Chloride Waterstop

Splices shall be made by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically designed for waterstop welding. The correct temperature shall be used to sufficiently melt without charring the plastic. The spliced area, when cooled, shall show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

3.2.3.3 Quality Assurance

Edge welding will not be permitted. Centerbulbs shall be compressed or closed when welding to non-centerbulb type. Waterstop splicing defects which are unacceptable include, but are not limited to the following: 1) Tensile strength less than 80 percent of parent section. 2) Free lap joints. 3) Misalignment of centerbulb, ribs, and end bulbs greater than 1/16 inch. 4) Misalignment which reduces waterstop cross section more than 15 percent. 5) Bond failure at joint deeper than 1/16 inch or 15 percent of material thickness. 6) Misalignment of waterstop splice resulting in misalignment of waterstop in excess of 1/2 inch in 10 feet. 7) Visible porosity in the weld area, including pin holes. 8) Charred or burnt material. 9) Bubbles or inadequate bonding. 10) Visible signs of splice separation when cooled splice is bent by hand at a sharp angle.

3.2.4 NOT USED

3.2.5 NOT USED

3.3 CONSTRUCTION JOINTS

Construction joints are specified in Section C-03300 CAST-IN-PLACE STRUCTURAL CONCRETE except that construction joints coinciding with expansion and contraction joints shall be treated as expansion or contraction joints as applicable.

--END OF SECTION--



## SECTION C-03300

### CAST-IN-PLACE STRUCTURAL CONCRETE

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

#### ACI INTERNATIONAL (ACI)

ACI 117/117R	(1990; Errata) Standard Tolerances for Concrete Construction and Materials
ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 214.3R	(1988) Simplified Version of the Recommended Practice for Evaluation of Strength Test Results
ACI 301	(1996) Standard Specifications for Structural Concrete
ACI 305R	(1991) Hot Weather Concreting
ACI 318/318R	(1995) Building Code Requirements for Reinforced Concrete and Commentary

#### AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS(AASHTO)

AASHTO M 182	(1991) Burlap Cloth Made From Jute or Kenaf
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#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 31	(1991) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1993) Concrete Aggregates
ASTM C 39	(1994) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42	(1994) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 94	(1996) Ready-Mixed Concrete
ASTM C 131	(1989) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1995a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143	(1990a) Slump of Hydraulic Cement Concrete
ASTM C 150	(1995) Portland Cement
ASTM C 171	(1995) Sheet Materials for Curing Concrete
ASTM C 172	(1990) Sampling Freshly Mixed Concrete

ASTM C 173	(1994a) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 192	(1990a) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(1991b) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM C 309	(1995) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 496	(1990) Splitting Tensile Strength of Cylindrical Concrete Specimens
ASTM C 552	(1991) Cellular Glass Thermal Insulation
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 618	(1996a) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 685	(1995) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C 881	(1990) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 940	(1989) Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C 1017	(1992) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1059	(1991) Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C 1064	(1986; R 1993) Temperature of Freshly Mixed Portland Cement Concrete
ASTM C 1077	(1995a) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1992) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM E 96	(1995) Water Vapor Transmission of Materials

ASTM E 1155 (1996) Determining Floor Flatness and Levelness Using the F-Number System

CORPS OF ENGINEERS (COE)

COE CRD-C 94 (1995) Surface Retarders

COE CRD-C 104 (1980) Method of Calculation of the Fineness Modulus of Aggregate

COE CRD-C 400 (1963) Requirements for Water for Use in Mixing or Curing Concrete

COE CRD-C 521 (1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete

COE CRD-C 572 (1974) Corps of Engineers Specifications for Polyvinyl-chloride Waterstop

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44 (1995) NIST Handbook 44: Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA TMMB-01 (1992) Truck Mixer Agitator and Front Discharge Concrete Carrier Standards of the Truck Mixer Manufacturers Bureau

NRMCA CPMB 100 (1990) Concrete Plant Standards

NRMCA QC 3 (1984) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production Facilities

1.2 NOT USED

1.3 NOT USED

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-08 Statements

Mixture Proportions; FIO.

The results of trial mixture design studies along with a statement giving the maximum nominal coarse aggregate size and the proportions of ingredients that will be used in the manufacture of each strength or class of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an approved independent commercial testing laboratory, showing that mixture design studies have been made with materials proposed for the project and that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used

in the mixture design studies without additional tests to show that the quality of the concrete is satisfactory.

#### SD-09 Reports

Testing and Inspection for Contractor Quality Control; FIO.

Certified copies of laboratory test reports, including mill tests and all other test data, for portland cement, pozzolan, aggregate, admixtures, and curing compound proposed for use on this project.

#### SD-13 Certificates

Qualifications; FIO.

Written documentation for Contractor Quality Control personnel.

#### SD-14 NOT USED

### 1.5 QUALIFICATIONS

Contractor Quality Control personnel assigned to concrete construction shall be American Concrete Institute (ACI) Certified Workmen in one of the following grades or shall have written evidence of having completed similar qualification programs:

Concrete Field Testing Technician, Grade I  
Concrete Laboratory Testing Technician, Grade I or II  
Concrete Construction Inspector, Level II

The foreman or lead journeyman of the flatwork finishing crew shall have similar qualification for ACI Concrete Flatwork Technician/Finisher or equal, with written documentation.

#### 1.6 NOT USED

#### 1.7 NOT USED

### 1.8 GENERAL REQUIREMENTS

#### 1.8.1 Tolerances

Except as otherwise specified herein, tolerances for concrete batching, mixture properties, and construction as well as definition of terms and application practices shall be in accordance with ACI 117/117R. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing; when forms or shoring are used, the measurements shall be made prior to removal.

##### 1.8.1.1 Floors

For the purpose of this Section the following terminology correlation between ACI 117/117R and this Section shall apply:

Floor Profile Quality Classification From ACI 117/117R -----	This Section -----
Conventional Bullfloated	Same
Conventional Straightedged	Same
Flat	Float Finish or Trowel Finish
Very Flat	Same. Use only with F-system

Levelness tolerance shall not apply where design requires floors to be sloped to drains or sloped for other reasons.

#### 1.8.1.2 Floors by the F-Number System

The flatness and levelness of floors shall be carefully controlled and the tolerances shall be measured by the F-Number system of Paragraph 4.5.6 and 4.5.6.1 of ACI 117/117R. The Contractor shall furnish an approved floor profilograph or other equipment capable of measuring the floor flatness (FF) number and the floor levelness (FL) number in accordance with ASTM E 1155. The Contractor shall perform the tolerance measurements within 72 hours after floor slab construction while being observed by the Contracting Officer. The tolerances of surfaces beyond the limits of ASTM E 1155 (the areas within 24 inches of embedments and construction joints) shall be acceptable to the Contracting Officer. Tolerances of the following areas shall meet the requirements for the listed surfaces as specified in paragraphs 4.5.6 and 4.5.6.1 of ACI 117/117R.

Trowel Finish- Areas  $F_F$  30/ $F_L$  20

#### 1.8.1.3 NOT USED

#### 1.8.2 Strength Requirements

##### 1.8.2.1 Strength Requirements

Specified compressive strength ( $f'_c$ ) shall be as follows:

COMPRESSIVE STRENGTH	STRUCTURE OR PORTION OF STRUCTURE
3000 psi at 28 days	Foundations and Interior Elevated Floor Slabs
4000 psi at 28 days	Building Slabs on Grade

Compressive strength shall be determined in accordance with ASTM C 39.

a. Evaluation of Concrete Compressive Strength. Compressive strength specimens (6 by 12 inch cylinders) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C 31 and tested in accordance with ASTM C 39. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength  $f'_c$  and no individual test result falls below the specified strength  $f'_c$  by more than 500 psi. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.

b. Investigation of Low-Strength Compressive Test Results. When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 500 psi or if tests of field-cured cylinders indicate

deficiencies in protection and curing, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Contracting Officer to least impair the strength of the structure. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. Non-destructive tests (tests other than test cylinders or cores) shall not be used as a basis for acceptance or rejection. The Contractor shall perform the coring and repair the holes. Cores will be tested by the Government.

c. Load Tests. If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Contracting Officer in accordance with the requirements of ACI 318/318R. Concrete work evaluated by structural analysis or by results of a load test as being understrength shall be corrected in a manner satisfactory to the Contracting Officer. All investigations, testing, load tests, and correction of deficiencies shall be performed by and at the expense of the Contractor and must be approved by the Contracting Officer, except that if all concrete is found to be in compliance with the drawings and specifications, the cost of investigations, testing, and load tests will be at the expense of the Government.

#### 1.8.2.2 NOT USED

#### 1.8.3 Air Entrainment

All normal weight concrete shall be air entrained to contain between 4 and 7 percent total air, except that when the nominal maximum size coarse aggregate is 3/4 inch or smaller it shall be between 4.5 and 7.5 percent. Specified air content shall be attained at point of placement into the forms. Air content for normal weight concrete shall be determined in accordance with ASTM C 231.

#### 1.8.4 Slump

Slump of the concrete, as delivered to the point of placement into the forms, shall be within the following limits. Slump shall be determined in accordance with ASTM C 143.

Structural Element	Slump	
	Minimum	Maximum
Walls, columns and beams	2 in.	4 in.
Foundation walls, substructure walls, footings, slabs	1 in.	3 in.
Any structural concrete approved for placement by pumping:		
At pump	2 in.	6 in.
At discharge of line	1 in.	4 in.

When use of a plasticizing admixture conforming to ASTM C 1017 or when a Type F or G high range water reducing admixture conforming to ASTM C 494 is permitted to increase the slump of concrete, concrete shall have a slump of 2 to 4 inches

before the admixture is added and a maximum slump of 8 inches at the point of delivery after the admixture is added.

#### 1.8.5 Concrete Temperature

The temperature of the concrete as delivered shall not exceed 90 degrees F. When the ambient temperature during placing is 40 degrees F or less, or is expected to be at any time within 6 hours after placing, the temperature of the concrete as delivered shall be between 55 and 75 degrees F.

#### 1.8.6 Size of Coarse Aggregate

The largest feasible nominal maximum size aggregate (NMSA) specified in paragraph AGGREGATES shall be used in each placement. However, nominal maximum size of aggregate shall not exceed any of the following: three-fourths of the minimum cover for reinforcing bars, three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

#### 1.8.7 Special Properties and Products

Concrete may contain admixtures other than air entraining agents, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if specified or approved. Any of these materials to be used on the project shall be used in the mix design studies.

#### 1.8.8 NOT USED

#### 1.8.9 NOT USED

### 1.9 MIXTURE PROPORTIONS

Concrete shall be composed of portland cement, other cementitious and pozzolanic materials as specified, aggregates, water and admixtures as specified.

#### 1.9.1 Proportioning Studies for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified shall be the responsibility of the Contractor. Except as specified for flexural strength concrete, mixture proportions shall be based on compressive strength as determined by test specimens fabricated in accordance with ASTM C 192 and tested in accordance with ASTM C 39. Samples of all materials used in mixture proportioning studies shall be representative of those proposed for use in the project and shall be accompanied by the manufacturer's or producer's test reports indicating compliance with these specifications. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required on the project. If pozzolan is used in the concrete mixture, the minimum pozzolan content shall be 15 percent by weight of the total cementitious material, and the maximum shall be 35 percent. Laboratory trial mixtures shall be designed for maximum permitted slump and air content. Separate sets of trial mixture studies shall be made for each combination of cementitious materials and each combination of admixtures proposed for use. No combination of either shall be used until proven by such studies, except that, if approved in writing and otherwise permitted by these specifications, an accelerator or a retarder may be used without separate trial mixture study. Separate trial mixture studies shall also be made for concrete for any conveying or placing method proposed which requires

special properties and for concrete to be placed in unusually difficult placing locations. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192. They shall be tested at 7 and 28 days in accordance with ASTM C 39. From these test results, a curve shall be plotted showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition, a curve shall be plotted showing the relationship between 7 day and 28 day strengths. Each mixture shall be designed to promote easy and suitable concrete placement, consolidation and finishing, and to prevent segregation and excessive bleeding.

1.9.2 NOT USED

1.9.3 NOT USED

#### 1.9.4 Average Compressive Strength Required for Mixtures

The mixture proportions selected during mixture design studies shall produce a required average compressive strength ( $f'_{cr}$ ) exceeding the specified compressive strength ( $f'_c$ ) by the amount indicated below. This required average compressive strength,  $f'_{cr}$ , will not be a required acceptance criteria during concrete production. However, whenever the daily average compressive strength at 28 days drops below  $f'_{cr}$  during concrete production, or daily average 7-day strength drops below a strength correlated with the 28-day  $f'_{cr}$ , the mixture shall be adjusted, as approved, to bring the daily average back up to  $f'_{cr}$ . During production, the required  $f'_{cr}$  shall be adjusted, as appropriate, based on the standard deviation being attained on the job.

##### 1.9.4.1 Computations from Test Records

Where a concrete production facility has test records, a standard deviation shall be established in accordance with the applicable provisions of ACI 214.3R. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths ( $f'_c$ ) within 1,000 psi of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. Required average compressive strength  $f'_{cr}$  used as the basis for selection of concrete proportions shall be the larger of the equations that follow using the standard deviation as determined above:

$$f'_{cr} = f'_c + 1.34S \text{ where units are in psi}$$

$$f'_{cr} = f'_c + 2.33S - 500 \text{ where units are in psi}$$

Where  $S$  = standard deviation

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS	MODIFICATION FACTOR FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03
30 or more	1.00



#### 1.9.4.2 Computations without Previous Test Records

When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength  $f'_{cr}$  shall be determined as follows:

- a. NOT USED
- b. If the specified compressive strength  $f'_c$  is 3000 to 5000 psi,  $f'_{cr} = f'_c + 1200$  psi.
- c. NOT USED

#### 1.9.5 NOT USED

#### 1.9.6 NOT USED

#### 1.10 STORAGE OF MATERIALS

Cement and other cementitious materials shall be stored in weathertight buildings, bins, or silos which will exclude moisture and contaminants and keep each material completely separated. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of aggregates. Aggregate shall not be stored directly on ground unless a sacrificial layer is left undisturbed. Reinforcing bars and accessories shall be stored above the ground on platforms, skids or other supports. Other materials shall be stored in such a manner as to avoid contamination and deterioration. Admixtures which have been in storage at the project site for longer than 6 months or which have been subjected to freezing shall not be used unless retested and proven to meet the specified requirements. Materials shall be capable of being accurately identified after bundles or containers are opened.

#### 1.11 GOVERNMENT ASSURANCE INSPECTION AND TESTING

Day-to day inspection and testing shall be the responsibility of the Contractor Quality Control (CQC) staff. However, representatives of the Contracting Officer can and will inspect construction as considered appropriate and will monitor operations of the Contractor's CQC staff. Government inspection or testing will not relieve the Contractor of any of his CQC responsibilities.

##### 1.11.1 Materials

The Government will sample and test aggregates, cementitious materials, other materials, and concrete to determine compliance with the specifications as considered appropriate. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Other materials will be sampled from storage at the jobsite or from other locations as considered appropriate. Samples may be placed in storage for later testing when appropriate.

##### 1.11.2 Fresh Concrete

Fresh concrete will be sampled as delivered in accordance with ASTM C 172 and tested in accordance with these specifications, as considered necessary.

### 1.11.3 Hardened Concrete

Tests on hardened concrete will be performed by the Government when such tests are considered necessary.

### 1.11.4 Inspection

Concrete operations may be tested and inspected by the Government as the project progresses. Failure to detect defective work or material will not prevent rejection later when a defect is discovered nor will it obligate the Government for final acceptance.

## PART 2 PRODUCTS

### 2.1 CEMENTITIOUS MATERIALS

Cementitious Materials shall be portland cement or portland cement in combination with pozzolan and shall conform to appropriate specifications listed below. Use of cementitious materials in concrete which will have surfaces exposed in the completed structure shall be restricted so there is no change in color, source, or type of cementitious material.

#### 2.1.1 Portland Cement

ASTM C 150, Type I with a maximum 15 percent amount of tricalcium aluminate.

#### 2.1.2 NOT USED

#### 2.1.3 NOT USED

#### 2.1.4 Pozzolan (Fly Ash)

ASTM C 618, Class C or F with the optional requirements for multiple factor, drying shrinkage, and uniformity from Table 2A of ASTM C 618. Requirement for maximum alkalis from Table 1A of ASTM C 618 shall apply. If pozzolan is used, it shall never be less than 15 percent nor more than 35 percent by weight of the total cementitious material.

#### 2.1.5 NOT USED

#### 2.1.6 NOT USED

### 2.2 AGGREGATES

Aggregates shall conform to the following.

#### 2.2.1 Fine Aggregate

Fine aggregate shall conform to the quality and gradation requirements of ASTM C 33.

#### 2.2.2 Coarse Aggregate

Coarse aggregate shall conform to ASTM C 33, Class 5S, size designation 57.

#### 2.2.3 NOT USED

#### 2.2.4 NOT USED

## 2.3 CHEMICAL ADMIXTURES

Chemical admixtures, when required or permitted, shall conform to the appropriate specification listed. Admixtures shall be furnished in liquid form and of suitable concentration for easy, accurate control of dispensing.

### 2.3.1 Air-Entraining Admixture

ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions.

### 2.3.2 Accelerating Admixture

ASTM C 494, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

### 2.3.3 Water-Reducing or Retarding Admixture

ASTM C 494, Type A, B, or D, except that the 6-month and 1-year compressive and flexural strength tests are waived.

### 2.3.4 High-Range Water Reducer

ASTM C 494, Type F or G, except that the 6-month and 1-year strength requirements are waived. The admixture shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

### 2.3.5 Surface Retarder

COE CRD-C 94.

### 2.3.6 NOT USED

### 2.3.7 Other Chemical Admixtures

Chemical admixtures for use in producing flowing concrete shall comply with ASTM C 1017, Type I or II. These admixtures shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

## 2.4 CURING MATERIALS

### 2.4.1 Impervious-Sheet

Impervious-sheet materials shall conform to ASTM C 171, type optional, except, that polyethylene sheet shall not be used.

### 2.4.2 Membrane-Forming Compound

Membrane-Forming curing compound shall conform to ASTM C 309, Type 1-D or 2, except that only a styrene acrylate or chlorinated rubber compound meeting Class B requirements shall be used for surfaces that are to be painted or are to receive bituminous roofing, or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing, or flooring specified. Nonpigmented compound shall contain a fugitive dye, and shall have the reflective requirements in ASTM C 309 waived.

#### 2.4.3 Burlap and Cotton Mat

Burlap and cotton mat used for curing shall conform to AASHTO M 182.

#### 2.5 WATER

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water may be used if it meets the requirements of COE CRD-C 400.

#### 2.6 NOT USED

#### 2.7 NOT USED

#### 2.8 LATEX BONDING AGENT

Latex agents for bonding fresh to hardened concrete shall conform to ASTM C 1059.

#### 2.9 EPOXY RESIN

Epoxy resins for use in repairs shall conform to ASTM C 881, Type V, Grade 2. Class as appropriate to the existing ambient and surface temperatures.

#### 2.10 EMBEDDED ITEMS

Embedded items shall be of the size and type indicated or as needed for the application. Dovetail slots shall be galvanized steel. Hangers for suspended ceilings shall be as specified in Section C-09510 ACOUSTICAL CEILINGS. Inserts for shelf angles and bolt hangers shall be of malleable iron or cast or wrought steel.

#### 2.11 FLOOR HARDENER

Floor hardener shall be a colorless aqueous solution containing zinc silicofluoride, magnesium silicofluoride, or sodium silicofluoride. These silicofluorides can be used individually or in combination. Proprietary hardeners may be used if approved in writing by the Contracting Officer.

#### 2.12 PERIMETER INSULATION

Perimeter insulation shall be 2" thick polystyrene conforming to ASTM C 578, Type II; polyurethane conforming to ASTM C 591, Type II; or cellular glass conforming to ASTM C 552, Type I or IV.

#### 2.13 VAPOR BARRIER

Vapor barrier shall be polyethylene sheeting with a minimum thickness of 6 mils or other equivalent material having a vapor permeance rating not exceeding 0.5 perms as determined in accordance with ASTM E96.

#### 2.14 JOINT MATERIALS

##### 2.14.1 Joint Fillers, Sealers, and Waterstops

Expansion joint fillers shall be preformed materials conforming to ASTM D 1751 or ASTM D 1752. Materials for waterstops shall be in accordance with Section C-03250 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS. Materials for and sealing of joints shall conform to the requirements of Section C-07920 JOINT SEALING and C-02592 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS.

2.14.2 NOT USED

2.15 NOT USED

2.16 NOT USED

### PART 3 EXECUTION

#### 3.1 PREPARATION FOR PLACING

Before commencing concrete placement, the following shall be performed. Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Forms shall be in place, cleaned, coated, and adequately supported, in accordance with Section C-03100 STRUCTURAL CONCRETE FORMWORK. Reinforcing steel shall be in place, cleaned, tied, and adequately supported, in accordance with Section C-03200 CONCRETE REINFORCEMENT. Transporting and conveying equipment shall be in place, ready for use, clean, and free of hardened concrete and foreign material. Equipment for consolidating concrete shall be at the placing site and in proper working order. Equipment and material for curing and for protecting concrete from weather or mechanical damage shall be at the placing site, in proper working condition and in sufficient amount for the entire placement. When hot, windy conditions during concreting appear probable, equipment and material shall be at the placing site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

##### 3.1.1 Foundations

###### 3.1.1.1 Concrete on Earth Foundations

Earth (subgrade, base, or subbase courses) surfaces upon which concrete is to be placed shall be clean, damp, and free from debris, frost, ice, and standing or running water. Prior to placement of concrete, the foundation shall be well drained and shall be satisfactorily graded and uniformly compacted.

###### 3.1.1.2 NOT USED

###### 3.1.1.3 Excavated Surfaces in Lieu of Forms

Concrete for footings may be placed directly against the soil provided the earth or rock has been carefully trimmed, is uniform and stable, and meets the compaction requirements of Section C-02221 EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS. The concrete shall be placed without becoming contaminated by loose material, and the outline of the concrete shall be within the specified tolerances.

##### 3.1.2 Previously Placed Concrete

###### 3.1.2.1 NOT USED

###### 3.1.2.2 NOT USED

###### 3.1.2.3 NOT USED

###### 3.1.2.4 NOT USED

###### 3.1.2.5 Preparation of Previously Placed Concrete

Concrete surfaces to which other concrete is to be bonded shall be abraded in an approved manner that will expose sound aggregate uniformly without damaging the concrete. Laitance and loose particles shall be removed. Surfaces shall be

thoroughly washed and shall be moist but without free water when concrete is placed.

### 3.1.3 Vapor Barrier

Vapor barrier shall be provided beneath the interior on-grade concrete floor slabs. The greatest widths and lengths practicable shall be used to eliminate joints wherever possible. Joints shall be lapped a minimum of 12 inches. Torn, punctured, or damaged vapor barrier material shall be removed and new vapor barrier shall be provided prior to placing concrete. For minor repairs, patches may be made using laps of at least 12 inches. Lapped joints shall be sealed and edges patched with pressure-sensitive adhesive or tape not less than 2 inches wide and compatible with the membrane. Vapor barrier shall be placed directly on underlying subgrade, base course, or capillary water barrier, unless it consists of crushed material or large granular material which could puncture the vapor barrier. In this case, the surface shall be choked with a light layer of sand, as approved, before placing the vapor barrier. A 2 inch layer of compacted, clean concrete sand (fine aggregate) shall be placed on top of the vapor barrier before placing concrete. Concrete placement shall be controlled so as to prevent damage to the vapor barrier, or any covering sand.

### 3.1.4 Perimeter Insulation

Perimeter insulation shall be installed at locations indicated. Adhesive shall be used where insulation is applied to the interior surface of foundation walls and may be used for exterior application.

### 3.1.5 Embedded Items

Before placement of concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Conduit and other embedded items shall be clean and free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids. Welding shall not be performed on embedded metals within 1 foot of the surface of the concrete. Tack welding shall not be performed on or to embedded items.

## 3.2 CONCRETE PRODUCTION

### 3.2.1 Batching, Mixing, and Transporting Concrete

Concrete shall either be batched and mixed onsite or shall be furnished from a ready-mixed concrete plant. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C 94, except as otherwise specified. Truck mixers, agitators, and nonagitating transporting units shall comply with NRMCA TMMB-01. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA QC 3. Approved batch tickets shall be furnished for each load of ready-mixed concrete. Site-mixed concrete shall conform to the following subparagraphs.

#### 3.2.1.1 General

The batching plant shall be located off site close to the project. The batching, mixing and placing system shall have a capacity of at least 50 cubic yards. The batching plant shall conform to the requirements of NRMCA CPMB 100 and as specified; however, rating plates attached to batch plant equipment are not required.

### 3.2.1.2 Batching Equipment

The batching controls shall be semiautomatic or automatic, as defined in NRMCA CPMB 100. A semiautomatic batching system shall be provided with interlocks such that the discharge device cannot be actuated until the indicated material is within the applicable tolerance. The batching system shall be equipped with accurate recorder or recorders that meet the requirements of NRMCA CPMB 100. The weight of water and admixtures shall be recorded if batched by weight. Separate bins or compartments shall be provided for each size group of aggregate and type of cementitious material, to prevent intermingling at any time. Aggregates shall be weighed either in separate weigh batchers with individual scales or, provided the smallest size is batched first, cumulatively in one weigh batcher on one scale. Aggregate shall not be weighed in the same batcher with cementitious material. If both portland cement and other cementitious material are used, they may be batched cumulatively, provided that the portland cement is batched first. Water may be measured by weight or volume. Water shall not be weighed or measured cumulatively with another ingredient. Filling and discharging valves for the water metering or batching system shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. Piping for water and for admixtures shall be free from leaks and shall be properly valved to prevent backflow or siphoning. Admixtures shall be furnished as a liquid of suitable concentration for easy control of dispensing. An adjustable, accurate, mechanical device for measuring and dispensing each admixture shall be provided. Each admixture dispenser shall be interlocked with the batching and discharging operation of the water so that each admixture is separately batched and individually discharged automatically in a manner to obtain uniform distribution throughout the water as it is added to the batch in the specified mixing period. When use of truck mixers makes this requirement impractical, the admixture dispensers shall be interlocked with the sand batchers. Different admixtures shall not be combined prior to introduction in water and shall not be allowed to intermingle until in contact with the cement. Admixture dispensers shall have suitable devices to detect and indicate flow during dispensing or have a means for visual observation. The plant shall be arranged so as to facilitate the inspection of all operations at all times. Suitable facilities shall be provided for obtaining representative samples of aggregates from each bin or compartment, and for sampling and calibrating the dispensing of cementitious material, water, and admixtures. Filling ports for cementitious materials bins or silos shall be clearly marked with a permanent sign stating the contents.

### 3.2.1.3 Scales

The weighing equipment shall conform to the applicable requirements of CPMB Concrete Plant Standard, and of NIST HB 44, except that the accuracy shall be plus or minus 0.2 percent of scale capacity. The Contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring devices. The tests shall be made at the specified frequency in the presence of a Government inspector. The weighing equipment shall be arranged so that the plant operator can conveniently observe all dials or indicators.

### 3.2.1.4 Batching Tolerances

#### (A) Tolerances with Weighing Equipment

MATERIAL	PERCENT OF REQUIRED WEIGHT
Cementitious materials	0 to plus 2
Aggregate	plus or minus 2

Water	plus or minus 1
Chemical admixture	0 to plus 6

(B) Tolerances with Volumetric Equipment

For volumetric batching equipment used for water and admixtures, the following tolerances shall apply to the required volume of material being batched:

MATERIAL	PERCENT OF REQUIRED MATERIAL
Water:	plus or minus 1 percent
Chemical admixtures:	0 to plus 6 percent

3.2.1.5 Moisture Control

The plant shall be capable of ready adjustment to compensate for the varying moisture content of the aggregates and to change the weights of the materials being batched.

3.2.1.6 Concrete Mixers

Mixers shall be stationary mixers or truck mixers. Mixers shall be capable of combining the materials into a uniform mixture and of discharging this mixture without segregation. The mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired.

3.2.1.7 Stationary Mixers

Concrete plant mixers shall be drum-type mixers of tilting, nontilting, horizontal-shaft, or vertical-shaft type, or shall be pug mill type and shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixing time and uniformity shall conform to all the requirements in ASTM C 94 applicable to central-mixed concrete.

3.2.1.8 Truck Mixers

Truck mixers, the mixing of concrete therein, and concrete uniformity shall conform to the requirements of ASTM C 94. A truck mixer may be used either for complete mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Each truck shall be equipped with two counters from which it is possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed. Water shall not be added at the placing site unless specifically approved; and in no case shall it exceed the specified w/c. Any such water shall be injected at the base of the mixer, not at the discharge end.

3.3 NOT USED

3.4 NOT USED

3.5 NOT USED



### 3.6 TRANSPORTING CONCRETE TO PROJECT SITE

Concrete shall be transported to the placing site in truck mixers, agitators, nonagitating transporting equipment conforming to NRMCA TMMB-01 or by approved pumping equipment conveyors.

### 3.7 CONVEYING CONCRETE ON SITE

Concrete shall be conveyed from mixer or transporting unit to forms as rapidly as possible and within the time interval specified by methods which will prevent segregation or loss of ingredients using following equipment. Conveying equipment shall be cleaned before each placement.

#### 3.7.1 Buckets

The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least 5 times the nominal maximum-size aggregate, and the area of the gate opening shall not be less than 2 square feet. The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically, or hydraulically operated except that buckets larger than 2 cubic yards shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

#### 3.7.2 Transfer Hoppers

Concrete may be charged into nonagitating hoppers for transfer to other conveying devices. Transfer hoppers shall be capable of receiving concrete directly from delivery vehicles and shall have conical-shaped discharge features. The transfer hopper shall be equipped with a hydraulically operated gate and with a means of external vibration to effect complete discharge. Concrete shall not be held in nonagitating transfer hoppers more than 30 minutes.

#### 3.7.3 Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C 94. Nonagitating equipment shall be used only for transporting plant-mixed concrete over a smooth road and when the hauling time is less than 15 minutes. Bodies of nonagitating equipment shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

#### 3.7.4 Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitating equipment, the chutes normally attached to this equipment by the manufacturer may be used. A discharge deflector shall be used when required by the Contracting Officer. Separate chutes and other similar equipment will not be permitted for conveying concrete.

### 3.7.5 Belt Conveyors

Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means, such as discharge baffle or hopper , for preventing segregation of the concrete at the transfer points and the point of placing. Belt conveyors shall be constructed such that the idler spacing shall not exceed 36 inches. The belt speed shall be a minimum of 300 feet per minute and a maximum of 750 feet per minute. If concrete is to be placed through installed horizontal or sloping reinforcing bars, the conveyor shall discharge concrete into a pipe or elephant truck that is long enough to extend through the reinforcing bars.

### 3.7.6 Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure type; pneumatic placing equipment shall not be used. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least 3 times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped but not less than 4 inches. Aluminum pipe shall not be used.

## 3.8 PLACING CONCRETE

Mixed concrete shall be discharged within 1-1/2 hours or before the mixer drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates. When the concrete temperature exceeds 85 degrees F, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the transporting unit. Concrete shall be handled from mixer or transporting unit to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing. Sufficient placing capacity shall be provided so that concrete can be kept free of cold joints.

### 3.8.1 Depositing Concrete

Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 5 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 12 inches thick, except that all slabs shall be placed in a single layer. Concrete to receive other construction shall be screeded to the proper level. Concrete shall be deposited continuously in one layer or in layers so that fresh concrete is deposited on in-place concrete that is still plastic. Fresh concrete shall not be deposited on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. Concrete that has surface dried, partially hardened, or contains foreign material shall not be used. When temporary spreaders are used in the forms, the spreaders shall be removed as their service becomes unnecessary. Concrete shall not be placed in slabs over columns and walls until concrete in columns and walls has been in-place at least two hours or until the concrete begins to lose its plasticity.

### 3.8.2 Consolidation

Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for slabs 4 inches thick or less. The vibrators shall

at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 10,000 vibrations per minute, an amplitude of at least 0.025 inch, and the head diameter shall be appropriate for the structural member and the concrete mixture being placed. Vibrators shall be inserted vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a reasonable amount. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then vertically withdrawn slowly while operating. Form vibrators shall not be used unless specifically approved and unless forms are constructed to withstand their use. Vibrators shall not be used to move concrete within the forms. Slabs 4 inches and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique. Frequency and amplitude of vibrators shall be determined in accordance with COE CRD-C 521. Grate tampers ("jitterbugs") shall not be used.

### 3.8.3 Cold Weather Requirements

Special protection measures, approved by the Contracting Officer, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 40 degrees F. The temperature of the concrete when placed shall be not less than 50 degrees F nor more than 75 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Upon written approval, an accelerating admixture conforming to ASTM C 494, Type C or E may be used, provided it contains no calcium chloride. Calcium chloride shall not be used.

### 3.8.4 Hot Weather Requirements

When the ambient temperature during concrete placing is expected to exceed 85 degrees F, the concrete shall be placed and finished with procedures previously submitted and as specified herein. The concrete temperature at time of delivery to the forms shall not exceed the temperature shown in the table below when measured in accordance with ASTM C 1064. Cooling of the mixing water or aggregates or placing concrete in the cooler part of the day may be required to obtain an adequate placing temperature. A retarder may be used, as approved, to facilitate placing and finishing. Steel forms and reinforcements shall be cooled as approved prior to concrete placement when steel temperatures are greater than 120 degrees F. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature.

Maximum Allowable Concrete Placing Temperature

Relative Humidity, Percent, During Time of Concrete Placement	Maximum Allowable Concrete Temperature Degrees
Greater than 60	90 F
40-60	85 F
Less than 40	80 F

### 3.8.5 Prevention of Plastic Shrinkage Cracking

During hot weather with low humidity, and particularly with appreciable wind, as well as interior placements when space heaters produce low humidity, the Contractor shall be alert to the tendency for plastic shrinkage cracks to develop and shall institute measures to prevent this. Particular care shall be taken if plastic shrinkage cracking is potentially imminent and especially if it has developed during a previous placement. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Fig. 2.1.5 of ACI 305R. In addition the concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, sprinkling, ponding or wet covering. Plastic shrinkage cracks that occur shall be filled by injection of epoxy resin as directed, after the concrete hardens. Plastic shrinkage cracks shall never be troweled over or filled with slurry.

### 3.8.6 Placing Concrete Underwater

Concrete shall not be deposited in water.

### 3.8.7 Placing Concrete in Congested Areas

Special care shall be used to ensure complete filling of the forms, elimination of all voids, and complete consolidation of the concrete when placing concrete in areas congested with reinforcing bars, embedded items, waterstops and other tight spacing. An appropriate concrete mixture shall be used, and the nominal maximum size of aggregate (NMSA) shall meet the specified criteria when evaluated for the congested area. Vibrators with heads of a size appropriate for the clearances available shall be used, and the consolidation operation shall be closely supervised to ensure complete and thorough consolidation at all points. Where necessary, splices of reinforcing bars shall be alternated to reduce congestion. Where two mats of closely spaced reinforcing are required, the bars in each mat shall be placed in matching alignment to reduce congestion.

### 3.8.8 NOT USED

## 3.9 JOINTS

Joints shall be located and constructed as indicated or approved. Joints not indicated on the drawings shall be located and constructed to minimize the impact on the strength of the structure. Joints in walls shall be at the tops of footings unless otherwise approved. Joints shall be perpendicular to the main reinforcement. All reinforcement shall be continued across joints; except that reinforcement or other fixed metal items shall not be continuous through expansion joints, or through construction or contraction joints in slabs on grade. Reinforcement shall be 2 inches clear from each joint. Except where otherwise indicated, construction joints between interior slabs on grade and vertical surfaces shall consist of 30 pound asphalt-saturated felt, extending for the full depth of the slab. The perimeters of the slabs shall be free of fins, rough edges, spalling, or other unsightly appearance. Reservoir for sealant for construction and contraction joints in slabs shall be formed to the dimensions shown on the drawings by sawing to widen the top portion of sawed joints. Joints to be sealed shall be cleaned and sealed as indicated and in accordance with Section C-07920 JOINT SEALING.

### 3.9.1 Construction Joints

For concrete other than slabs on grade, construction joints shall be located so that the unit of operation does not exceed 60 feet. Concrete shall be placed continuously so that each unit is monolithic in construction. Fresh concrete shall not be placed against adjacent hardened concrete until it is at least 24

hours old. Construction joints shall be located as indicated or approved. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint shall be subject to approval of the Contracting Officer. Unless otherwise indicated and except for slabs on grade, reinforcing steel shall extend through construction joints. Construction joints in slabs on grade shall be keyed or doweled as shown. Concrete, walls, or piers shall be in place at least 2 hours, or until the concrete begins to lose its plasticity, before placing concrete for slabs thereon. Horizontal construction joints in foundation walls are not permitted.

### 3.9.2 Contraction Joints in Slabs on Grade

Contraction joints shall be located and detailed as shown on the drawings. Contraction Joints shall be produced by forming a weakened plane in the concrete slab by sawing a continuous slot with a concrete saw. The slot shall be 1/4 the depth of the slab thickness and between 1/8 and 3/16 inch wide. For saw-cut joints, cutting shall be timed properly with the set of the concrete. Cutting shall be started as soon as the concrete has hardened sufficiently to prevent raveling of the edges of the saw cut. Cutting shall be completed before shrinkage stresses become sufficient to produce cracking. Reservoir for joint sealant shall be formed as previously specified.

### 3.9.3 Expansion Joints

Installation of expansion joints and sealing of these joints shall conform to the requirements of Section C-03250 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS and Section C-07920 JOINT SEALING.

### 3.9.4 Waterstops

Waterstops shall be installed in conformance with the locations and details shown on the drawings using materials and procedures specified in Section C-03250 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

### 3.9.5 Dowels and Tie Bars

Dowels and tie bars shall be installed at the locations shown on the drawings and to the details shown, using materials and procedures specified in Section C-03200 CONCRETE REINFORCEMENT and herein. Conventional smooth "paving" dowels shall be installed in slabs using approved methods to hold the dowel in place during concreting within a maximum alignment tolerance of 1/8 inch in 12 inches. "Structural" type deformed bar dowels, or tie bars, shall be installed to meet the specified tolerances. Care shall be taken during placing adjacent to and around dowels and tie bars to ensure there is no displacement of the dowel or tie bar and that the concrete completely embeds the dowel or tie bar and is thoroughly consolidated.

## 3.10 FINISHING FORMED SURFACES

Forms, form materials, and form construction are specified in Section C-03100 STRUCTURAL CONCRETE FORMWORK. Finishing of formed surfaces shall be as specified herein. Unless another type of architectural or special finish is specified, surfaces shall be left with the texture imparted by the forms except that defective surfaces shall be repaired. Unless painting of surfaces is required, uniform color of the concrete shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure that requires a Class A or B finish. Except for major defects, as defined hereinafter, surface defects shall be repaired as specified herein within 24 hours after forms are removed. Repairs of the so-called "plaster-type" will not be permitted in any location. Tolerances of formed surfaces shall conform

to the requirements of ACI 117/117R. These tolerances apply to the finished concrete surface, not to the forms themselves; forms shall be set true to line and grade. Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter shall be repaired as specified in paragraph Damp-Pack Mortar Repair. Defects whose surface diameter is greater than their depth shall be repaired as specified in paragraph Repair of Major Defects. Repairs shall be finished flush with adjacent surfaces and with the same surface texture. The cement used for all repairs shall be a blend of job cement with white cement proportioned so that the final color after curing and aging will be the same as the adjacent concrete. Concrete with excessive honeycomb, or other defects which affect the strength of the member, will be rejected. Repairs shall be demonstrated to be acceptable and free from cracks or loose or drummy areas at the completion of the contract and, for Class A and B Finishes, shall be inconspicuous. Repairs not meeting these requirements will be rejected and shall be replaced.

#### 3.10.1 Class B Finish

Class B finish is required in the following areas: exposed surfaces of the Scheduled Maintenance Pit and all other surfaces exposed to view. Fins, ravelings, and loose material shall be removed, all surface defects over 1/2 inch in diameter or more than 1/2 inch deep, shall be repaired and, except as otherwise indicated or as specified in Section C-03100 STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Defects more than 1/2 inch in diameter shall be cut back to sound concrete, but in all cases at least 1 inch deep.

#### 3.10.2 Class D Finish

Class D finish is required in the following areas: all areas not exposed to view. Fins, ravelings, and loose material shall be removed, and, except as otherwise indicated or as specified in Section C-03100 STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Honeycomb and other defects more than 1/2 inch deep or more than 2 inches in diameter shall be repaired. Defects more than 2 inches in diameter shall be cut back to sound concrete, but in all cases at least 1 inch deep.

#### 3.10.3 NOT USED

### 3.11 REPAIRS

#### 3.11.1 Damp-Pack Mortar Repair

Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter but not over 4 inches shall be repaired by the damp-pack mortar method. Form tie holes shall be reamed and other similar defects shall be cut out to sound concrete. The void shall then be thoroughly cleaned, thoroughly wetted, brush-coated with a thin coat of neat cement grout and filled with mortar. Mortar shall be a stiff mix of 1 part portland cement to 2 parts fine aggregate passing the No. 16 mesh sieve, and minimum amount of water. Only sufficient water shall be used to produce a mortar which, when used, will stick together on being molded into a ball by a slight pressure of the hands and will not exude water but will leave the hands damp. Mortar shall be mixed and allowed to stand for 30 to 45 minutes before use with remixing performed immediately prior to use. Mortar shall be thoroughly tamped in place in thin layers using a hammer and hardwood block. Holes passing entirely through walls shall be completely filled from the inside face by forcing mortar through to the outside face. All holes shall be packed full. Damp-pack repairs shall be moist cured for at least 48 hours.

### 3.11.2 Repair of Major Defects

Major defects will be considered to be those more than 1/2 inch deep or, for Class B finishes, more than 1/2 inch in diameter and, for Class D finishes, more than 2 inches in diameter. Also included are any defects of any kind whose depth is over 4 inches or whose surface diameter is greater than their depth. Major defects shall be repaired as specified below.

#### 3.11.2.1 Surface Application of Mortar Repair

Defective concrete shall be removed, and removal shall extend into completely sound concrete. Approved equipment and procedures which will not cause cracking or microcracking of the sound concrete shall be used. If reinforcement is encountered, concrete shall be removed so as to expose the reinforcement for at least 2 inches on all sides. All such defective areas greater than 12 square inches shall be outlined by saw cuts at least 1 inch deep. Defective areas less than 12 square inches shall be outlined by a 1 inch deep cut with a core drill in lieu of sawing. All saw cuts shall be straight lines in a rectangular pattern in line with the formwork panels. After concrete removal, the surface shall be thoroughly cleaned by high pressure washing to remove all loose material. Surfaces shall be kept continually saturated for the first 12 of the 24 hours immediately before placing mortar and shall be damp but not wet at the time of commencing mortar placement. The Contractor, at his option, may use either hand-placed mortar or mortar placed with a mortar gun. If hand-placed mortar is used, the edges of the cut shall be perpendicular to the surface of the concrete. The prepared area shall be brush-coated with a thin coat of neat cement grout. The repair shall then be made using a stiff mortar, preshrunk by allowing the mixed mortar to stand for 30 to 45 minutes and then remixed, thoroughly tamped into place in thin layers. If hand-placed mortar is used, the Contractor shall test each repair area for drumminess by firm tapping with a hammer and shall inspect for cracks, both in the presence of the Contracting Officer's representative, immediately before completion of the contract, and shall replace any showing drumminess or cracking. If mortar placed with a mortar gun is used, the gun shall be a small compressed air-operated gun to which the mortar is slowly hand fed and which applies the mortar to the surface as a high-pressure stream, as approved. Repairs made using shotcrete equipment will not be accepted. The mortar used shall be the same mortar as specified for damp-pack mortar repair. If gun-placed mortar is used, the edges of the cut shall be beveled toward the center at a slope of 1:1. All surface applied mortar repairs shall be continuously moist cured for at least 7 days. Moist curing shall consist of several layers of saturated burlap applied to the surface immediately after placement is complete and covered with polyethylene sheeting, all held closely in place by a sheet of plywood or similar material rigidly braced against it. Burlap shall be kept continually wet.

#### 3.11.2.2 Repair of Deep and Large Defects

Deep and large defects will be those that are more than 6 inches deep and also have an average diameter at the surface more than 18 inches or that are otherwise so identified by the Project Office. Such defects shall be repaired as specified herein or directed, except that defects which affect the strength of the structure shall not be repaired and that portion of the structure shall be completely removed and replaced. Deep and large defects shall be repaired by procedures approved in advance including forming and placing special concrete using applied pressure during hardening. Preparation of the repair area shall be as specified for surface application of mortar. In addition, the top edge (surface) of the repair area shall be sloped at approximately 20 degrees from the horizontal, upward toward the side from which concrete will be placed. The special concrete shall be a concrete mixture with low water content and low slump, and shall be allowed to age 30 to 60 minutes before use. Concrete

containing a specified expanding admixture may be used in lieu of the above mixture; the paste portion of such concrete mixture shall be designed to have an expansion between 2.0 and 4.0 percent when tested in accordance with ASTM C 940. A full width "chimney" shall be provided at the top of the form on the placing side to ensure filling to the top of the opening. A pressure cap shall be used on the concrete in the chimney with simultaneous tightening and revibrating the form during hardening to ensure a tight fit for the repair. The form shall be removed after 24 hours and immediately the chimney shall be carefully chipped away to avoid breaking concrete out of the repair; the surface of the repair concrete shall be dressed as required.

### 3.11.3 NOT USED

## 3.12 FINISHING UNFORMED SURFACES

The finish of all unformed surfaces shall meet the requirements of paragraph Tolerances in PART 1, when tested as specified herein.

### 3.12.1 General

The ambient temperature of spaces adjacent to unformed surfaces being finished and of the base on which concrete will be placed shall be not less than 50 degrees F. In hot weather all requirements of paragraphs Hot Weather Requirements and Prevention of Plastic Shrinkage Cracking shall be met. Unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish, with additional finishing as specified below, and shall be true to the elevation shown on the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown on the drawings, properly consolidated, and left true and regular. Unless otherwise shown on the drawings, exterior surfaces shall be sloped for drainage, as directed. Where drains are provided, interior floors shall be evenly sloped to the drains. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Grate tampers or "jitterbugs" shall not be used for any surfaces. The dusting of surfaces with dry cement or other materials or the addition of any water during finishing shall not be permitted. If bleedwater is present prior to finishing, the excess water shall be carefully dragged off or removed by absorption with porous materials such as burlap. During finishing operations, extreme care shall be taken to prevent over finishing or working water into the surface; this can cause "crazing" (surface shrinkage cracks which appear after hardening) of the surface. Any slabs with surfaces which exhibit significant crazing shall be removed and replaced. During finishing operations, surfaces shall be checked with a 10 foot straightedge, applied in both directions at regular intervals while the concrete is still plastic, to detect high or low areas.

### 3.12.2 Rough Slab Finish

As a first finishing operation for unformed surfaces and as final finish for slabs to receive mortar setting beds for ceramic tile, the surface shall receive a rough slab finish prepared as follows. The concrete shall be uniformly placed across the slab area, consolidated as previously specified, and then screeded with straightedge strikeoffs immediately after consolidation to bring the surface to the required finish level with no coarse aggregate visible. Side forms and screed rails shall be provided, rigidly supported, and set to exact line and grade. Allowable tolerances for finished surfaces apply only to the hardened concrete, not to forms or screed rails. Forms and screed rails shall be set true to line and grade. "Wet screeds" shall not be used.



### 3.12.3 Floated Finish

Slabs to receive more than a rough slab finish shall next be given a wood float finish. The screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. Then, after the concrete has stiffened so that it will withstand a man's weight without imprint of more than 1/4 inch and the water sheen has disappeared, it shall be floated to a true and even plane free of ridges. Floating shall be performed by use of suitable hand floats or power driven equipment. Sufficient pressure shall be used on the floats to bring a film of moisture to the surface. Hand floats shall be made of wood, magnesium, or aluminum. Lightweight concrete or concrete that exhibits stickiness shall be floated with a magnesium float. Care shall be taken to prevent over-finishing or incorporating water into the surface.

### 3.12.4 Troweled Finish

All floor slabs shall receive a troweled finish except those areas specified in Section 3.12.3 and 3.12.6.1. After floating is complete and after the surface moisture has disappeared, unformed surfaces shall be steel-troweled to a smooth, even, dense finish, free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. Additional trowelings shall be performed, either by hand or machine until the surface has been troweled a minimum of 3 times, with waiting period between each. Care shall be taken to prevent blistering and if such occurs, troweling shall immediately be stopped and operations and surfaces corrected. A final hard steel troweling shall be done by hand, with the trowel tipped, and using hard pressure, when the surface is at a point that the trowel will produce a ringing sound. The finished surface shall be thoroughly consolidated and shall be essentially free of trowel marks and be uniform in texture and appearance. The concrete mixture used for troweled finished areas shall be adjusted, if necessary, in order to provide sufficient fines (cementitious material and fine sand) to finish properly.

### 3.12.5 NOT USED

### 3.12.6 Non-Slip Finish

Non-slip floors shall be constructed in accordance with the following subparagraphs.

#### 3.12.6.1 Broomed

The following areas: ramps, entrances and stoops shall be given a broomed finish. After floating, the surface shall be lightly steel troweled, and then carefully scored by pulling a hair or coarse fiber push-type broom across the surface. Brooming shall be transverse to traffic or at right angles to the slope of the slab. After the end of the curing period, the surface shall be vigorously broomed with a coarse fiber broom to remove all loose or semi-detached particles.

#### 3.12.6.2 NOT USED

#### 3.12.7 NOT USED

#### 3.12.8 NOT USED

#### 3.12.9 NOT USED

### 3.13 FLOOR HARDENER

Areas as indicated on the drawings shall be treated with floor hardener. Floor hardener shall be applied after the concrete has been cured and then air dried for 28 days. Three coats shall be applied, each the day after the preceding coat was applied. For the first application, one pound of the silicofluoride shall be dissolved in one gallon of water. For subsequent applications, the solution shall be two pounds of silicofluoride to each gallon of water. Floor should be mopped with clear water shortly after the preceding application has dried to remove encrusted salts. Proprietary hardeners shall be applied in accordance with the manufacturer's instructions. During application, area should be well ventilated. Precautions shall be taken when applying silicofluorides due to the toxicity of the salts. Any compound that contacts glass or aluminum should be immediately removed with clear water.

### 3.14 EXTERIOR SLAB AND RELATED ITEMS

#### 3.14.1 NOT USED

#### 3.14.2 NOT USED

#### 3.14.3 NOT USED

#### 3.14.4 Pits and Trenches

Pits and trenches shall be constructed as indicated on the drawings. Bottoms and walls shall be placed monolithically or waterstops and keys, shall be provided as approved.

### 3.15 CURING AND PROTECTION

#### 3.15.1 General

Concrete shall be cured by an approved method for a period of 7 days.

Immediately after placement, concrete shall be protected from premature drying, extremes in temperatures, rapid temperature change, mechanical injury and damage from rain and flowing water for the duration of the curing period. Air and forms in contact with concrete shall be maintained at a temperature above 50 degrees F for the first 3 days and at a temperature above 32 degrees F for the remainder of the specified curing period. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure, and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete surfaces or to create fire hazards. Materials and equipment needed for adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat, including welding, shall be permitted near or in direct contact with the concrete at any time. Except as otherwise permitted by paragraph Membrane Forming Curing Compounds, moist curing shall be provided for any areas to receive floor hardener, any paint or other applied coating, or to which other concrete is to be bonded. Except for plastic coated burlap, impervious sheeting alone shall not be used for curing.

#### 3.15.2 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, commencing immediately after finishing. If water or curing materials used stain or discolor concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned as approved. When wooden forms are left in place during curing, they shall be kept wet at all times. If steel forms are used in hot weather, nonsupporting vertical forms shall be broken loose

from the concrete soon after the concrete hardens and curing water continually applied in this void. If the forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Burlap and mats shall be clean and free from any contamination and shall be completely saturated before being placed on the concrete. The Contractor shall have an approved work system to ensure that moist curing is continuous 24 hours per day.

### 3.15.3 Membrane Forming Curing Compounds

Membrane curing shall not be used on floor slabs which are to be treated with a hardener, or will receive ceramic tile or surfaces that are to receive any subsequent treatment depending on adhesion or bonding to the concrete, including surfaces to which a smooth finish is to be applied or other concrete to be bonded. However, a styrene acrylate or chlorinated rubber compound meeting ASTM C 309, Class B requirements, may be used for surfaces which are to be painted or are to receive bituminous roofing or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing or flooring specified. Membrane curing compound shall not be used on surfaces that are maintained at curing temperatures with free steam. Curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface. All surfaces shall be thoroughly moistened with water. Curing compound shall be applied to slab surfaces as soon as the bleeding water has disappeared, with the tops of joints being temporarily sealed to prevent entry of the compound and to prevent moisture loss during the curing period. The curing compound shall be applied in a two-coat continuous operation by approved motorized power-spraying equipment operating at a minimum pressure of 75 psi, at a uniform coverage of not more than 400 square feet per gallon for each coat, and the second coat shall be applied perpendicular to the first coat. Concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified. Surfaces on which clear compound is used shall be shaded from direct rays of the sun for the first 3 days. Surfaces coated with curing compound shall be kept free of foot and vehicular traffic, and from other sources of abrasion and contamination during the curing period.

### 3.15.4 Impervious Sheeting

The following concrete surfaces may be cured using impervious sheets: floor slabs which receive ceramic tile or VCT finish. However, except for plastic coated burlap, impervious sheeting alone shall not be used for curing. Impervious-sheet curing shall only be used on horizontal or nearly horizontal surfaces. Surfaces shall be thoroughly wetted and be completely covered with the sheeting. Sheeting shall be at least 18 inches wider than the concrete surface to be covered. Covering shall be laid with light-colored side up. Covering shall be lapped not less than 12 inches and securely weighted down or shall be lapped not less than 4 inches and taped to form a continuous cover with completely closed joints. The sheet shall be weighted to prevent displacement so that it remains in contact with the concrete during the specified length of curing. Coverings shall be folded down over exposed edges of slabs and secured by approved means. Sheets shall be immediately repaired or replaced if tears or holes appear during the curing period.

#### 3.15.5 Ponding or Immersion

Concrete shall be continually immersed throughout the curing period. Water shall not be more than 20 degrees F less than the temperature of the concrete.

#### 3.15.6 Cold Weather Curing and Protection

When the daily ambient low temperature is less than 32 degrees F the temperature of the concrete shall be maintained above 40 degrees F for the first seven days after placing. During the period of protection removal, the air temperature adjacent to the concrete surfaces shall be controlled so that concrete near the surface will not be subjected to a temperature differential of more than 25 degrees F as determined by suitable temperature measuring devices furnished by the Government, as required, and installed adjacent to the concrete surface and 2 inches inside the surface of the concrete. The installation of the thermometers shall be made by the Contractor as directed.

#### 3.16 SETTING BASE PLATES AND BEARING PLATES

After being properly positioned, column base plates, bearing plates for beams and similar structural members shall be set to the proper line and elevation with damp-pack bedding mortar. The thickness of the mortar or grout shall be approximately 1/24 the width of the plate, but not less than 3/4 inch. Concrete and metal surfaces in contact with grout shall be clean and free of oil and grease, and concrete surfaces in contact with grout shall be damp and free of laitance when grout is placed.

##### 3.16.1 Damp-Pack Bedding Mortar

Damp-pack bedding mortar shall consist of 1 part cement and 2-1/2 parts fine aggregate having water content such that a mass of mortar tightly squeezed in the hand will retain its shape but will crumble when disturbed. The space between the top of the concrete and bottom of the bearing plate or base shall be packed with the bedding mortar by tamping or ramming with a bar or rod until it is completely filled.

##### 3.16.2 NOT USED

#### 3.17 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL

The Contractor shall perform the inspection and tests described below and, based upon the results of these inspections and tests, shall take the action required and shall submit specified reports. When, in the opinion of the Contracting Officer, the concreting operation is out of control, concrete placement shall cease and the operation shall be corrected. The laboratory performing the tests shall be onsite and shall conform with ASTM C 1077. Materials may be subjected to check testing by the Government from samples obtained at the manufacturer, at transfer points, or at the project site. The Government will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and at other times as deemed necessary by the government to verify conformance with ASTM C 1077.

##### 3.17.1 Grading and Corrective Action

###### 3.17.1.1 Fine Aggregate

At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 and COE CRD-C 104 for the fine aggregate or for each fine aggregate if it is batched in more than one size or classification. The location at which

samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits. When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall immediately reported to the Contracting Officer, concreting shall be stopped, and immediate steps taken to correct the grading.

#### 3.17.1.2 Coarse Aggregate

At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C 136 for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control coarser than the specification limits for samples taken other than as delivered to the mixer to allow for degradation during handling. When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Contracting Officer. Where two consecutive averages of 5 tests are outside specification limits, the operation shall be considered out of control and shall be reported to the Contracting Officer. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

#### 3.17.2 Quality of Aggregates

Thirty days prior to the start of concrete placement, the Contractor shall perform all tests for aggregate quality required by ASTM C 33. In addition, after the start of concrete placement, the Contractor shall perform tests for aggregate quality at least every three months, and when the source of aggregate or aggregate quality changes. Samples tested after the start of concrete placement shall be taken immediately prior to entering the concrete mixer.

#### 3.17.3 Scales, Batching and Recording

The accuracy of the scales shall be checked by test weights prior to start of concrete operations and at least once every three months. Such tests shall also be made as directed whenever there are variations in properties of the fresh concrete that could result from batching errors. Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. At the same time, the Contractor shall test and ensure that the devices for dispensing admixtures are operating properly and accurately. When either the weighing accuracy or batching accuracy does not comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected immediately.

#### 3.17.4 Batch-Plant Control

The measurement of concrete materials including cementitious materials, each size of aggregate, water, and admixtures shall be continuously controlled. The aggregate weights and amount of added water shall be adjusted as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of cement used, type and source of

pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic yard, amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic yard for each class of concrete batched during each day's plant operation.

### 3.17.5 Concrete Mixture

a. Air Content Testing. Air content tests shall be made when test specimens are fabricated. In addition, at least two tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Tests shall be made in accordance with ASTM C 231 for normal weight concrete and ASTM C 173 for lightweight concrete. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single test result reaches either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the air content and the control chart for range, and for determining need for any remedial action. The result of each test, or average as noted in the previous sentence, shall be plotted on a separate control chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph Air Entrainment. An upper warning limit and a lower warning limit line shall be set 1.0 percentage point above and below the average line, respectively. An upper action limit and a lower action limit line shall be set 1.5 percentage points above and below the average line, respectively. The range between each two consecutive tests shall be plotted on a secondary control chart for range where an upper warning limit is set at 2.0 percentage points and an upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the air content at the mixer controlled as directed.

b. Air Content Corrective Action. Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air-entraining admixture batched. As soon as practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the secondary control chart for range reaches the warning limit, the admixture dispenser shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted.

c. Slump Testing. In addition to slump tests which shall be made when test specimens are fabricated, at least four slump tests shall be made on randomly selected batches in accordance with ASTM C 143 for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower

action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the slump of the batch to plot on both the control charts for slump and the chart for range, and for determining need for any remedial action. Limits shall be set on separate control charts for slump for each type of mixture. The upper warning limit shall be set at 1/2 inch below the maximum allowable slump specified in paragraph Slump in PART 1 for each type of concrete and an upper action limit line and lower action limit line shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at 2 inches. Samples for slump shall be taken at the mixer. However, the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's materials or transportation methods cause slump loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the slump at the mixer controlled as directed.

d. Slump Corrective Action. Whenever points on the control charts for slump reach the upper warning limit, an adjustment shall immediately be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount allowed by the maximum w/c ratio specified, based on aggregates which are in a saturated surface dry condition. When a single slump reaches the upper or lower action limit, no further concrete shall be delivered to the placing site until proper adjustments have been made. Immediately after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive individual slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range at or above the upper action limit, the concreting operation shall immediately be halted, and the Contractor shall take appropriate steps to bring the slump under control. Additional slump tests shall be made as directed.

e. Temperature. The temperature of the concrete shall be measured when compressive strength specimens are fabricated. Measurement shall be in accordance with ASTM C 1064. The temperature shall be reported along with the compressive strength data.

f. Strength Specimens. At least one set of test specimens shall be made, for compressive or flexural strength as appropriate, on each different concrete mixture placed during the day for each 500 cubic yards or portion thereof of that concrete mixture placed each day. Additional sets of test specimens shall be made, as directed by the Contracting Officer, when the mixture proportions are changed or when low strengths have been detected. A truly random (not haphazard) sampling plan shall be developed by the Contractor and approved by the Contracting Officer prior to the start of construction. The plan shall assure that sampling is done in a completely random and unbiased manner. A set of test specimens for concrete with a 28-day specified strength per paragraph Strength Requirements in PART 1 shall consist of four specimens, two to be tested at 7 days and two at 28 days. Test specimens shall be molded and cured in accordance with ASTM C 31 and tested in accordance with ASTM C 39 for test cylinders. Results of all strength tests shall be reported immediately to the Contracting Officer. Quality control charts shall be kept for individual strength "tests", ("test" as defined in paragraph Strength Requirements in PART 1) moving average of last 3 "tests" for strength, and moving average for range for the last 3 "tests" for each mixture. The charts shall be similar to those found in ACI 214.3R.

#### 3.17.6 Inspection Before Placing

Foundations, construction joints, forms, and embedded items shall be inspected by the Contractor in sufficient time prior to each concrete placement in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

#### 3.17.7 Placing

The placing foreman shall supervise placing operations, shall determine that the correct quality of concrete or grout is placed in each location as specified and as directed by the Contracting Officer, and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, volume placed, and method of placement. The placing foreman shall not permit batching and placing to begin until it has been verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

#### 3.17.8 Vibrators

The frequency and amplitude of each vibrator shall be determined in accordance with COE CRD-C 521 prior to initial use and at least once a month when concrete is being placed. Additional tests shall be made as directed when a vibrator does not appear to be adequately consolidating the concrete. The frequency shall be determined while the vibrator is operating in concrete with the tachometer being held against the upper end of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be determined with the head vibrating in air. Two measurements shall be taken, one near the tip and another near the upper end of the vibrator head, and these results averaged. The make, model, type, and size of the vibrator and frequency and amplitude results shall be reported in writing. Any vibrator not meeting the requirements of paragraph Consolidation, shall be immediately removed from service and repaired or replaced.

#### 3.17.9 Curing Inspection

a. Moist Curing Inspections. At least once each shift, and not less than twice per day on both work and non-work days, an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.

b. Moist Curing Corrective Action. When a daily inspection report lists an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for those areas shall be extended by 1 day.

c. Membrane Curing Inspection. No curing compound shall be applied until the Contractor has verified that the compound is properly mixed and ready for spraying. At the end of each operation, the Contractor shall estimate the quantity of compound used by measurement of the container and the area of concrete surface covered, shall compute the rate of coverage in square feet per gallon, and shall note whether or not coverage is uniform.

d. Membrane Curing Corrective Action. When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.



e. Sheet Curing Inspection. At least once each shift and once per day on non-work days, an inspection shall be made of all areas being cured using impervious sheets. The condition of the covering and the tightness of the laps and tapes shall be noted and recorded.

f. Sheet Curing Corrective Action. When a daily inspection report lists any tears, holes, or laps or joints that are not completely closed, the tears and holes shall promptly be repaired or the sheets replaced, the joints closed, and the required curing period for those areas shall be extended by 1 day.

#### 3.17.10 Cold-Weather Protection

At least once each shift and once per day on non-work days, an inspection shall be made of all areas subject to cold-weather protection. Any deficiencies shall be noted, corrected, and reported.

#### 3.17.11 Mixer Uniformity

a. Stationary Mixers. Prior to the start of concrete placing and once every 6 months when concrete is being placed, or once for every 75,000 cubic yards of concrete placed, whichever results in the shortest time interval, uniformity of concrete mixing shall be determined in accordance with ASTM C 94.

b. Truck Mixers. Prior to the start of concrete placing and at least once every 6 months when concrete is being placed, uniformity of concrete mixing shall be determined in accordance with ASTM C 94. The truck mixers shall be selected randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of the blades may be regarded as satisfactory.

c. Mixer Uniformity Corrective Action. When a mixer fails to meet mixer uniformity requirements, either the mixing time shall be increased, batching sequence changed, batch size reduced, or adjustments shall be made to the mixer until compliance is achieved.

#### 3.17.12 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all contractor quality control records.

--END OF SECTION--

SECTION C-04200

MASONRY

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI SP-66 (1994) ACI Detailing Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82 (1994) Steel Wire, Plain, for Concrete Reinforcement

ASTM A 153 (1996) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 615 (1995) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM C 55 (1995) Concrete Building Brick

ASTM C 67 (1994) Sampling and Testing Brick and Structural Clay Tile

ASTM C 90 (1995) Load-Bearing Concrete Masonry Units

ASTM C 140 (1995a) Sampling and Testing Concrete Masonry Units

ASTM C 216 (1995) Facing Brick (Solid Masonry Units Made from Clay or Shale)

ASTM C 270 (1995) Mortar for Unit Masonry

ASTM C 476 (1991) Grout for Masonry

ASTM C 494 (1992) Chemical Admixtures for Concrete

ASTM C 641 (1982; R 1991) Staining Materials in Lightweight Concrete Aggregates

ASTM C 780 (1994) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry

ASTM C 1019 (1989a; R 1993) Sampling and Testing Grout

ASTM C 1072	(1994) Measurement of Masonry Flexural Bond Strength
ASTM D 2000	(1990; R 1994) Rubber Products in Automotive Applications
ASTM D 2240	(1991) Rubber Property - Durometer Hardness
ASTM D 2287	(1992) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E 119	(1995a) Fire Tests of Building Construction and Materials
ASTM E 447	(1992b) Compressive Strength of Masonry Prisms

#### FEDERAL SPECIFICATIONS (FS)

FS HH-I-1972/1	(Basic; Notice 1) Insulation Board, Thermal, Polyurethane or Polyisocyanurate, Faced With Aluminum Foil on Both Sides of the Foam
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#### 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION C-01330 SUBMITTAL PROCEDURES:

SD-01 NOT USED

SD-04 Drawings

Masonry Work; GA.

Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; and wall openings. Bar splice locations shall be shown. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall openings greater than one masonry unit in area shall be shown. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, the approved shop drawings shall be resubmitted with the additional openings shown along with the proposed changes. Location of these additional openings shall be clearly highlighted. The minimum scale for wall elevations shall be 1/4 inch per foot. Reinforcement bending details shall conform to the requirements of ACI SP-66.

Scaffold Plan; FIO. Drawings indicating type and location of scaffolding and sequence of work.

SD-08 NOT USED

SD-09 Reports

Efflorescence Test; FIO.

Field Testing of Mortar; FIO.

Field Testing of Grout; FIO.

Fire-rated CMU; FIO.

Test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project.

Special Inspection; FIO.

Copies of masonry inspector reports.

#### SD-14 Samples

Concrete Brick; GA.

Clay or Shale Brick; GA.

### 1.3 SAMPLE MASONRY PANELS

After material samples are approved and prior to starting masonry work, sample masonry panels shall be constructed for each type and color of masonry required. At least 48 hours prior to constructing the sample panel or panels, the Contractor shall submit written notification to the Contracting Officer's Representative. Sample panels shall not be built in, or as part of the structure, but shall be located where directed.

#### 1.3.1 Configuration

Panels shall be L-shaped or otherwise configured to represent all of the wall elements. Panels shall be of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project. The minimum size of a straight panel or a leg of an L-shaped panel shall be 8 feet long by 4 feet high.

#### 1.3.2 Composition

Panels shall show full color range, texture, and bond pattern of the masonry work. The Contractor's method for mortar joint tooling; grouting of reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work shall be demonstrated during the construction of the panels. Installation or application procedures for wall ties, CMU control joints, brick expansion joints, insulation, flashing, and weepholes shall be shown in the sample panels. The panels shall contain a masonry bonded corner that includes a bond beam corner. Panels shall show installation of electrical boxes and conduit. Panels that represent reinforced masonry shall contain a 2 foot by 2 foot opening placed at least 2 feet above the panel base and 2 feet away from all free edges, corners, and control joints. Required reinforcing shall be provided around this opening as well as at wall corners and control joints.

#### 1.3.3 Construction Method

Where anchored veneer walls are required, the Contractor shall demonstrate and receive approval for the method of construction; i.e., either bring up the two wythes together or separately, with the insulation and appropriate ties placed within the specified tolerances across the cavity. Temporary provisions shall

be demonstrated to preclude mortar or grout droppings in the cavity and to provide a clear open air space of the dimensions shown on the drawings. Where masonry is to be grouted, the Contractor shall demonstrate and receive approval on the method that will be used to bring up the masonry wythes; support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. Panels shall be built on a properly designed concrete foundation.

#### 1.3.4 Usage

The completed panels shall be used as the standard of workmanship for the type of masonry represented. Masonry work shall not commence until the sample panel for that type of masonry construction has been completed and approved. Panels shall be protected from the weather and construction operations until the masonry work has been completed and approved. After completion of the work, the sample panels, including all foundation concrete, shall become the property of the Contractor and shall be removed from the construction site.

#### 1.4 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, and protected to avoid chipping, breakage, and contact with soil or contaminating material.

##### 1.4.1 Masonry Units

Concrete masonry units shall be covered or protected from inclement weather and shall conform to the moisture content as specified in ASTM C 90 when delivered to the jobsite.

##### 1.4.2 Reinforcement and Ties

Steel reinforcing bars, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

##### 1.4.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

#### 1.5 SPECIAL INSPECTION

A qualified masonry inspector approved by the Contracting Officer shall perform inspection of the masonry work. Minimum qualifications for the masonry inspector shall be 5 years of reinforced masonry inspection experience or acceptance by a State, municipality, or other governmental body having a program of examining and certifying inspectors for reinforced masonry construction. The masonry inspector shall be present during preparation of masonry prisms, sampling and placing of masonry units, placement of reinforcement (including placement of dowels in footings and foundation walls), inspection of grout space, immediately prior to closing of cleanouts, and during grouting operations. The masonry inspector shall assure Contractor compliance with the drawings and specifications. The masonry inspector shall keep a complete record of all inspections and shall submit daily written reports to the Quality Control Supervisory Representative reporting the quality of masonry construction. The masonry inspector shall be hired by the prime contractor and shall inspect only the CMU construction.

## PART 2 PRODUCTS

### 2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval.

### 2.2 CLAY OR SHALE BRICK

Color range and texture of clay or shale brick shall be as indicated and shall conform to the approved sample. Grade SW shall be used for all brick. Brick shall be tested for efflorescence. Clay or shale brick units shall be delivered factory-blended to provide a uniform appearance and color range in the completed wall.

#### 2.2.1 Solid Clay or Shale Brick

Solid clay or shale shall be scored and shall conform to ASTM C 216, Type FBS. Brick size shall be modular and the nominal size of the brick used shall be 4 inches thick, 8 inches wide, and 16 inches long. Minimum compressive strength of the brick shall be 3000 psi. Brick shall be tested for efflorescence.

#### 2.2.2 NOT USED

### 2.3 CONCRETE BRICK

Concrete brick shall conform to ASTM C 55, Type I, Grade N-I. Concrete brick may be used where necessary for filling out in concrete masonry unit construction.

### 2.4 CONCRETE MASONRY UNITS (CMU)

Hollow and solid concrete masonry units shall conform to ASTM C 90, Type I, Lightweight or Normal weight. Cement shall have a low alkali content and be of one brand. Lightweight units shall be used in walls bearing on the second floor deck. Lightweight or normal weight may be used in all other walls except those used in the exterior cavity walls which must be normal weight. Concrete masonry units shall be tested for efflorescence.

#### 2.4.1 Aggregates

Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units, shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C 641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification.

#### 2.4.2 Kinds and Shapes

Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. In exposed interior masonry surfaces, units having a bullnose shall be used where indicated. Radius of the bullnose shall be 1 inch. Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.

#### 2.4.2.1 NOT USED

#### 2.4.2.2 NOT USED

#### 2.4.3 Fire-Rated CMU

Concrete masonry units used in fire-rated construction shown on the drawings shall be of minimum equivalent thickness for the fire rating indicated and the corresponding type of aggregates indicated in TABLE I. Units containing more than one of the aggregates listed in TABLE I will be rated on the aggregate requiring the greater minimum equivalent thickness to produce the required fire rating.

TABLE I  
FIRE-RATED CONCRETE MASONRY UNITS

See note (a) below

Aggregate Type	Minimum equivalent thickness in inches for fire rating of:		
	4 hours	3 hours	2 hours
Pumice	4.7	4.0	3.0
Expanded slag	5.0	4.2	3.3
Expanded clay, shale, or slate	5.7	4.8	3.7
Limestone, scoria, cinders or unexpanded slag	5.9	5.0	4.0
Calcareous gravel	6.2	5.3	4.2
Siliceous gravel	6.7	5.7	4.5

(a) Minimum equivalent thickness shall equal net volume as determined in conformance with ASTM C 140 divided by the product of the actual length and height of the face shell of the unit in inches. Where walls are to receive plaster or be faced with brick, or otherwise form an assembly; the thickness of plaster or brick or other material in the assembly will be included in determining the equivalent thickness.

2.5 NOT USED

2.6 NOT USED

2.7 NOT USED

2.8 PRECAST CONCRETE ITEMS

Splashblocks shall be factory-made units from a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, concrete shall be 4,000 psi minimum conforming to Section C-03300 CONCRETE FOR BUILDING CONSTRUCTION using 1/2 inch to No. 4 nominal-size coarse aggregate, and minimum reinforcement shall be the reinforcement required for handling of the units. Clearance of 3/4 inch shall be maintained between reinforcement and faces of units. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 120 pounds per square inch for at least 5 hours, the items, after casting, shall be either damp-cured for 24 hours or steam-cured and shall then be aged under cover for 28 days or longer. Cast-concrete members weighing over 80 pounds shall have built-in loops of galvanized wire or other approved provisions for lifting and anchoring. Units shall have beds and joints at right angles to the face, with sharp true arises. Exposed-to-view surfaces shall be free of surface voids, spalls, cracks, and chipped or

broken edges. Precast units exposed-to-view shall be of uniform appearance and color. Unless otherwise specified, units shall have a smooth dense finish. Prior to use, each item shall be wetted and inspected for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.

#### 2.8.1 NOT USED

#### 2.8.2 NOT USED

#### 2.8.3 Splash Blocks

Splash blocks shall be as detailed. Reinforcement shall be the manufacturer's standard.

#### 2.9 NOT USED

#### 2.10 MORTAR

Mortar shall be Type S, with a minimum compressive strength of 1800 psi, in accordance with the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate. Pointing mortar in showers shall contain ammonium stearate, or aluminum tri-stearate, or calcium stearate in an amount equal to 3 percent by weight of cement used. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source. Mortar shall be tested for efflorescence.

##### 2.10.1 Admixtures

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494, Type C.

##### 2.10.2 Coloring

Mortar coloring shall be added to the mortar used for exposed masonry surfaces to produce a uniform color as indicated on the color finish schedule in the drawings. Mortar coloring shall not exceed 3 percent of the weight of cement for carbon black and ten percent of the weight of cement for all other pigments. Mortar coloring shall be chemically inert, of finely ground limeproof pigment, and furnished in accurately pre-measured and packaged units that can be added to a measured amount of cement.

#### 2.11 GROUT

Grout shall conform to ASTM C 476. Cement used in grout shall have a low alkali content. Grout shall contain a plasticizer, slump shall be between 8 and 10 inches after addition of plasticizer. Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements. Grout shall be tested for efflorescence.

##### 2.11.1 Admixtures

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494, Type C.

##### 2.11.2 Grout Barriers



Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

## 2.12 TIES AND BAR POSITIONERS

Ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153, Class B-2. Steel wire used for ties shall be fabricated from steel wire conforming to ASTM A 82. Ties shall be sized to provide a minimum of 5/8 inch mortar cover from either face.

### 2.12.1 NOT USED

### 2.12.2 Wall Ties

Wall ties shall be rectangular-shaped fabricated of 3/16 inch diameter zinc-coated steel wire. Rectangular wall ties shall be no less than 4 inches wide. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT. Adjustable type wall ties, if approved for use, shall consist of two essentially U-shaped elements fabricated of 3/16 inch diameter zinc-coated steel wire. Adjustable ties shall be of the double pintle to eye type and shall allow a maximum of 1/2 inch eccentricity between each element of the tie. Play between pintle and eye opening shall be not more than 1/16 inch. The pintle and eye elements shall be formed so that both can be in the same plane.

### 2.12.3 NOT USED

### 2.12.4 NOT USED

### 2.12.5 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

## 2.13 JOINT REINFORCEMENT

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A 82, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A 153, class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 5/8 inch cover from either face. The distance between crosswires shall not exceed 16 inches. Joint reinforcement for straight runs shall be furnished in flat sections not less than 10 feet long. Joint reinforcement shall be provided with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features.

## 2.14 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615, Grade 60.

## 2.15 CONTROL JOINT KEYS

Control joint keys shall be a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D 2000 or polyvinyl chloride conforming to ASTM D 2287. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 5/8 inch thick and 3/8 inch thick flanges, with a tolerance of plus or minus 1/16 inch. The control joint key shall fit neatly, but without forcing,

in masonry unit jamb sash grooves. The control joint key shall be flexible at a temperature of minus 30 degrees F after five hours exposure, and shall have a durometer hardness of not less than 70 when tested in accordance with ASTM D 2240.

## 2.16 EXPANSION-JOINT MATERIALS

2.16.1 Backer rod and sealant for brick expansion joint shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section C-07920 JOINT SEALING.

### 2.16.2 Building Expansion Joint

The building expansion joint closure shall be non-reinforced elastomeric bellows with a bifurcated waterproof attachment to metal flanges. The joint closure shall be 60 mil EPDM bellows with 0.018 inches stainless steel flanges with a face width of 4 inches.

## 2.17 INSULATION

### 2.17.1 Rigid Board-Type Insulation

Rigid board-type insulation shall be polyisocyanurate. Polyisocyanurate shall conform to ASTM C 1289, Type I, Class 2, faced with aluminum foil on both sides of the foam. The insulation shall be a standard product and shall be marked with not less than the manufacturer's trademark or name, the specification number, the permeance and R-values.

#### 2.17.1.1 Insulation Thickness and Air Space

The cavity space shall allow for a maximum insulation thickness of 2 inches and a minimum air space of 3/4 inch.

#### 2.17.1.2 Aged R-Value

The insulation shall provide a minimum aged R-value of 11 for the overall thickness. The aged R-value shall be determined at 75 degrees F in accordance with the appropriate referenced specification. The stated R-value of the insulation shall be certified by an independent testing laboratory or certified by an independent Registered Professional Engineer if tests are conducted in the manufacturer's laboratory.

#### 2.17.1.3 Recovered Material

Insulation shall contain the highest practicable percentage of recovered material derived from solid waste (but material reused in the manufacturing process cannot be counted toward the percentage of recovered material). Where two materials have the same price and performance, the one containing the higher recovered material content shall be provided. The polyurethane or polyisocyanurate foam shall have a minimum recovered material content of 9 percent by weight of the core material.

### 2.17.2 Insulation Adhesive

Insulation adhesive shall be specifically prepared to adhere the insulation to the masonry and, where applicable, to the thru-wall flashing. The adhesive shall not deleteriously affect the insulation, and shall have a record of satisfactory and proven performance for the conditions under which to be used.

## 2.18 FLASHING

Flashing shall be as specified in Section C-07600 SHEET METALWORK, GENERAL.

#### 2.19 WEEP HOLE VENTILATORS

Weephole ventilators shall be prefabricated aluminum grill type vents designed to prevent insect entry with maximum air entry. Ventilators shall be sized to match modular construction with a standard 3/8 inch mortar joint.

### PART 3 EXECUTION

#### 3.1 ENVIRONMENTAL REQUIREMENTS

##### 3.1.1 Hot Weather Installation

The following precautions shall be taken if masonry is erected when the ambient air temperature is more than 99 degrees F in the shade and the relative humidity is less than 50 percent. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 4 feet ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

##### 3.1.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 40 degrees F, a written statement of proposed cold weather construction procedures shall be submitted for approval. The following precautions shall be taken during all cold weather erection.

###### 3.1.2.1 Preparation

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

a. Air Temperature 40 to 32 Degrees F. Sand or mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120 degrees F.

b. Air Temperature 32 to 25 Degrees F. Sand and mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing.

c. Air Temperature 25 to 20 Degrees F. Sand and mixing water shall be heated to provide mortar temperatures between 40 degrees F and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 15 mph.

d. Air Temperature 20 Degrees F and below. Sand and mixing water shall be heated to provide mortar temperatures between 40 degrees F and 120 degrees F. Enclosure and auxiliary heat shall be provided to maintain air temperature above 32 degrees F. Temperature of units when laid shall not be less than 20 degrees F.

###### 3.1.2.2 Completed Masonry and Masonry Not Being Worked On

a. Mean daily air temperature 40 degrees F to 32 degrees F. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.

b. Mean daily air temperature 32 degrees F to 25 degrees F. Masonry shall be completely covered with weather-resistant membrane for 24 hours.

c. Mean Daily Air Temperature 25 Degrees F to 20 Degrees F. Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.

d. Mean Daily Temperature 20 Degrees F and Below. Masonry temperature shall be maintained above 32 degrees F for 24 hours by enclosure and supplementary

heat, by electric heating blankets, infrared heat lamps, or other approved methods.

#### 3.1.2.3 NOT USED

### 3.2 LAYING MASONRY UNITS

Masonry units shall be laid in running bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 1/2 inch. Each unit shall be adjusted to its final position while mortar is still soft and plastic. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be free from chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythe from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below.

#### 3.2.1 Surface Preparation

Surfaces upon which masonry is placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 1/8 inch. Sandblasting shall be used, if necessary, to remove laitance from pores and to expose the aggregate.

#### 3.2.2 Forms and Shores

Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

#### 3.2.3 Concrete Masonry Units

Units in piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below grade shall be grouted solid. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved. Double walls shall be stiffened at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung plumbing fixtures when chair carriers are not specified.

### 3.2.4 Clay or Shale Brick Units

Brick facing shall be laid with the better face exposed. Brick shall be laid in running bond with each course bonded at corners, unless otherwise indicated. Molded brick shall be laid with the frog side down. Brick that is cored, recessed, or has other deformations may be used in sills, treads, soldier courses, except where deformations will be exposed to view.

#### 3.2.4.1 Wetting of Units

Wetting of clay or shale brick units having an initial rate of absorption of more than 1 gram per minute per square inch of bed surface shall be in conformance with ASTM C 67. The method of wetting shall ensure that each unit is nearly saturated but surface dry when laid.

#### 3.2.4.2 Solid Units

Bed, head, and collar joints shall be completely filled with mortar.

#### 3.2.4.3 NOT USED

### 3.2.5 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Masonry shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II

#### TOLERANCES

Variation from the plumb in the lines  
and surfaces of columns, walls and arises

---

In adjacent masonry units	1/8 inch
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variations from the plumb for external corners,  
expansion joints, and other conspicuous lines

---

In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variations from the level for exposed lintels,  
sills, parapets, horizontal grooves, and other  
conspicuous lines

---

In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variation from level for bed joints and top  
surfaces of bearing walls

---

In 10 feet	1/4 inch
In 40 feet or more	1/2 inch

#### Variations from horizontal lines

---

In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

#### Variations in cross sectional dimensions of columns and in thickness of walls

---

Minus	1/4 inch
Plus	1/2 inch

### 3.2.6 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

### 3.2.7 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

#### 3.2.7.1 Flush Joints

Joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas shall be flush cut. Flush cut joints shall be made by cutting off the mortar flush with the face of the wall. Joints in unparged masonry walls below grade shall be pointed tight.

#### 3.2.7.2 Tooled Joints

Joints in exposed exterior and interior masonry surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

#### 3.2.7.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch.

### 3.2.8 Joint Widths

Joint widths shall be as follows:

#### 3.2.8.1 Concrete Masonry Units

Concrete masonry units shall have 3/8 inch joints.

#### 3.2.8.2 NOT USED

#### 3.2.8.3 Brick

Brick joint widths shall be the difference between the actual and nominal dimensions of the brick in either height or length. Brick expansion joint widths shall be as shown.

#### 3.2.9 Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mount electrical outlet boxes in wet locations shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully embedded in the mortar. Cells receiving anchor bolts and cells of the first course below bearing plates shall be filled with grout.

#### 3.2.10 Unfinished Work

Unfinished work shall be stepped back for joining with new work. Toothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

#### 3.2.11 Masonry Wall Intersections

Each course shall be masonry bonded at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

#### 3.2.12 Partitions

Partitions shall be continuous from floor to underside of floor or roof deck where shown. Openings in firewalls around joists or other structural members shall be filled as indicated or approved. Where suspended ceilings on both sides of partitions are indicated, the partitions other than those shown to be continuous may be stopped approximately 4 inches above the ceiling level. An isolation joint shall be placed in the intersection between partitions and structural or exterior walls as shown. Cells within vertical plane of ties shall be filled solid with grout for full height of partition or solid masonry units may be used. Interior partitions shall be tied together with joint reinforcement. Partitions containing joint reinforcement shall be provided with prefabricated pieces at corners and intersections or partitions.

### 3.3 ANCHORED VENEER CONSTRUCTION

The inner and outer wythes shall be completely separated by a continuous airspace as shown on the drawings. Both the inner and the outer wythes shall be laid up together except when adjustable joint reinforcement assemblies are approved for use. When both wythes are not brought up together, through-wall flashings shall be protected from damage until they are fully enclosed in the wall. The airspace between the wythes shall be kept clear and free of mortar droppings by temporary wood strips laid on the wall ties and carefully lifted out before placing the next row of ties. A coarse gravel or drainage material shall be placed behind the weep holes in the cavity to a minimum depth of 4 inches of coarse aggregate or 10 inches of drainage material to keep mortar droppings from plugging the weep holes.

### 3.4 WEEP HOLES

Weep holes shall be provided not more than 24 inches on centers in mortar joints of the exterior wythe above wall flashing, over foundations, bond beams, and any other horizontal interruptions of the cavity. Weep holes shall be constructed using weep hole ventilators. Other approved methods may be used for providing weep holes. Weep holes shall be kept free of mortar and other obstructions.

3.5 NOT USED

3.6 NOT USED

3.7 NOT USED

3.8 NOT USED

3.9 MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2-1/2 hours after mixing shall be discarded.

3.10 REINFORCING STEEL

Reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 2 inches of tops of walls.

3.10.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Column and pilaster ties shall be wired in position around the vertical steel. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

3.10.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

3.11 JOINT REINFORCEMENT

Joint reinforcement shall be installed at 16 inches on center or as indicated. Reinforcement shall be lapped not less than 6 inches. Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be placed to provide not less than 5/8 inch cover to either face of the unit.

3.12 PLACING GROUT



Cells containing reinforcing bars shall be filled with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

#### 3.12.1 NOT USED

#### 3.12.2 Horizontal Grout Barriers

Grout barriers shall be embedded in mortar below cells of hollow units receiving grout.

#### 3.12.3 Grout Holes

##### 3.12.3.1 Grout Holes

Holes shall be located over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Openings shall not be less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, grouting holes shall be plugged and finished to match surrounding surfaces.

##### 3.12.3.2 NOT USED

##### 3.12.3.3 NOT USED

#### 3.12.4 Grouting Equipment

##### 3.12.4.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, waste materials and debris shall be removed from the equipment, and disposed of outside the masonry.

##### 3.12.4.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. At least one spare vibrator shall be maintained at the site at all times. Vibrators shall be applied at uniformly spaced points not further apart than the visible effectiveness of the machine. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation.

#### 3.12.5 Grout Placement

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may

be used on pours up to and including 5 feet in height. High-lift grout methods shall be used on pours exceeding 5 feet in height.

#### 3.12.5.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 1/2 inch into the grout space shall be removed before beginning the grouting operation. Grout pours 12 inches or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 12 inches in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

#### 3.12.5.2 NOT USED

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (feet) (3)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (in.) (1,2)
			Hollow-unit Masonry
1	Fine	Low Lift	1-1/2 x 2
5	Fine	Low Lift	2 x 3
1	Coarse	Low Lift	1-1/2 x 3
5	Coarse	Low Lift	2-1/2 x 3

#### Notes:

(1) The actual grout space or cell dimension must be larger than the sum of the following items:

a) The required minimum dimensions of total clear areas given in the table above;

b) The width of any mortar projections within the space;

c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.

(2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 3/4 inch or greater in width.

(3) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between horizontal bond beams.

#### 3.13 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be

lapped 48 bar diameters. A minimum clearance of 1/2 inch shall be maintained between reinforcement and interior faces of units.

### 3.14 CONTROL JOINTS

Control joints shall be provided as indicated and shall be constructed by using special control-joint units or sash jamb units with control joint key in accordance with the details shown on the drawings. Sash jamb units shall have a 3/4 by 3/4 inch groove near the center at end of each unit. The vertical mortar joint at control joint locations shall be continuous, including through all bond beams. This shall be accomplished by utilizing half blocks in alternating courses on each side of the joint. The control joint key shall be interrupted in courses containing continuous bond beam steel. Exposed interior control joints shall be raked to a depth of 3/4 inch. Concealed control joints shall be flush cut.

### 3.15 BRICK EXPANSION JOINTS AND BUILDING EXPANSION JOINTS

#### 3.15.1 Brick Expansion Joints

Brick expansion joints shall be provided and constructed as shown on the drawings. Joints shall be kept free of mortar and other debris.

#### 3.15.2 Building Expansion Joints

Building expansion joints shall be provided and constructed as shown on the drawings. Expansion joint closure shall be installed in accordance with manufacturer's specifications and conventional sheet metal practices. Adjoining sections shall be overlapped 4 inches shingle fashion to provide watershed. All intersections shall be prefabricated by the manufacturer of the closure.

### 3.16 NOT USED

### 3.17 LINTELS

#### 3.17.1 Masonry Lintels

Masonry lintels shall be constructed with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 1/2-inch above the bottom inside surface of the lintel unit.

#### 3.17.2 Steel Lintels

Steel lintels shall be as shown on the drawings. Lintels shall be set in a full bed of mortar with faces plumb and true. Steel shall have a minimum bearing length of 8 inches unless otherwise indicated on the drawings. Steel lintels shall be hot-dip galvanized in conformance with ASTM A123.

### 3.18 NOT USED

### 3.19 NOT USED

### 3.20 NOT USED

### 3.21 INSULATION

Anchored veneer walls shall be insulated, where shown, by installing board-type insulation on the cavity side of the inner wythe. Board type insulation shall

be applied directly to the masonry or thru-wall flashing with adhesive. Insulation shall be neatly fitted between obstructions without impaling of insulation on ties or anchors. The insulation shall be applied in parallel courses with vertical joints breaking midway over the course below and shall be applied in moderate contact with adjoining units without forcing, and shall be cut to fit neatly against adjoining surfaces.

### 3.22 SPLASH BLOCKS

Splash blocks shall be located as shown.

### 3.23 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashings shall be completely removed from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

#### 3.23.1 Concrete Masonry Unit and Concrete Brick Surfaces

Exposed concrete masonry unit and concrete brick surfaces shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

#### 3.23.2 Clay or Shale Brick Surfaces

Exposed clay or shale brick masonry surfaces shall be cleaned as necessary to obtain surfaces free of stain, dirt, mortar and grout daubs, efflorescence, and discoloration or scum from cleaning operations. After cleaning, the sample panel of similar material shall be examined for discoloration or stain as a result of cleaning. If the sample panel is discolored or stained, the method of cleaning shall be changed to assure that the masonry surfaces in the structure will not be adversely affected. The exposed masonry surfaces shall be water-soaked and then cleaned with a solution proportioned 1/2 cup trisodium phosphate and 1/2 cup laundry detergent to one gallon of water or cleaned with a proprietary masonry cleaning agent specifically recommended for the color and texture by the clay products manufacturer. The solution shall be applied with stiff fiber brushes, followed immediately by thorough rinsing with clean water. Proprietary cleaning agents shall be used in conformance with the cleaning product manufacturer's printed recommendations. Efflorescence shall be removed in conformance with the brick manufacturer's recommendations.

#### 3.23.3 NOT USED

### 3.24 BEARING PLATES

Bearing plates for beams, joists, joist girders and similar structural members shall be set to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Non-shrink grout shall be as specified in Section C-03300 CONCRETE FOR BUILDING CONSTRUCTION.

### 3.25 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 2 feet down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

### 3.26 TEST REPORTS

#### 3.26.1 Field Testing of Mortar

At least three specimens of mortar shall be taken each day. A layer of mortar 1/2 to 5/8 inch thick shall be spread on the masonry units and allowed to stand for one minute. The specimens shall then be prepared and tested for compressive strength in accordance with ASTM C 780.

#### 3.26.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C 1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 2000 psi at 28 days.

#### 3.26.3 Efflorescence Test

Brick, scored brick, CMU, mortar, and grout shall be tested for efflorescence. Tests shall be scheduled far enough in advance of starting masonry work to permit retesting if necessary. Sampling and testing shall conform to the applicable provisions of ASTM C 67. Units meeting the definition of "effloresced" will be subjected to rejection.

-- End of Section --

SECTION C-05055

WELDING, STRUCTURAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC-04 (1989) Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT-01 (1996) Recommended Practice SNT-TC-1A

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (1993) Symbols for Welding, Brazing and Nondestructive Examination

AWS A3.0 (1994) Standard Welding Terms and Definitions

AWS D1.1 (1994) Structural Welding Code - Steel

AWS Z49.1 (1994) Safety in Welding and Cutting and Allied Processes

1.2 DEFINITIONS

Definitions of welding terms shall be in accordance with AWS A3.0.

1.3 GENERAL REQUIREMENTS

The design of welded connections shall conform to AISC-04 unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Welding shall be as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Welding shall not be started until welding procedures, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Qualification testing shall be performed at or near the work site. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-08 NOT USED

## SD-18 Records

Quality Control; FIO.

A quality assurance plan and records of tests and inspections including welding procedure specifications and qualification records for the welder, welding operator, tacker and inspector.

### 1.5 WELDING PROCEDURE QUALIFICATIONS

Except for prequalified (per AWS D1.1) and previously qualified procedures, each Contractor performing welding shall record in detail and shall qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Qualification of welding procedures shall conform to AWS D1.1 and to the specifications in this section. Copies of the welding procedure specification and the results of the procedure qualification test for each type of welding which requires procedure qualification shall be submitted for approval. Approval of any procedure, however, will not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the requirements of these specifications. This information shall be submitted on the forms in Appendix E of AWS D1.1. Welding procedure specifications shall be individually identified and shall be referenced on the detail drawings and erection drawings, or shall be suitably keyed to the contract drawings. In case of conflict between this specification and AWS D1.1, this specification governs.

#### 1.5.1 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without requalification if the following conditions are met:

a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

#### 1.5.2 Prequalified Procedures

Welding procedures which are considered prequalified as specified in AWS D1.1 will be accepted without further qualification. The Contractor shall submit for approval a listing or an annotated drawing to indicate the joints not prequalified. Procedure qualification shall be required for these joints.

#### 1.5.3 Retests

If welding procedure fails to meet the requirements of AWS D1.1, the procedure specification shall be revised and requalified, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1. If the welding procedure is qualified through retesting, all test results, including those of test welds that failed to meet the requirements, shall be submitted with the welding procedure.

### 1.6 WELDER, WELDING OPERATOR, AND TACKER QUALIFICATION

Each welder, welding operator, and tacker assigned to work on this contract shall be qualified in accordance with the applicable requirements of AWS D1.1 and as

specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

#### 1.6.1 Previous Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without requalification if all the following conditions are met:

a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.

b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

#### 1.6.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, the Contractor shall submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. The certification shall state the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. The certification shall be kept on file, and 3 copies shall be furnished. The certification shall be kept current for the duration of the contract.

#### 1.6.3 Renewal of Qualification

Requalification of a welder or welding operator shall be required under any of the following conditions:

a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.

b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.

c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified shall be submitted as evidence of conformance.

d. A tacker who passes the qualification test shall be considered eligible to perform tack welding indefinitely in the positions and with the processes for which he is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker shall be required to pass the prescribed tack welding test.

#### 1.7 INSPECTOR QUALIFICATION



Inspection and nondestructive testing personnel shall be qualified in accordance with the requirements of ASNT-01 for Levels I or II in the applicable nondestructive testing method. The inspector may be supported by assistant welding inspectors who are not qualified to ASNT-01, and assistant inspectors may perform specific inspection functions under the supervision of the qualified inspector.

#### 1.8 SYMBOLS

Symbols shall be in accordance with AWS A2.4, unless otherwise indicated.

#### 1.9 SAFETY

Safety precautions during welding shall conform to AWS Z49.1.

### PART 2 PRODUCTS

#### 2.1 WELDING EQUIPMENT AND MATERIALS

All welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1.

### PART 3 EXECUTION

#### 3.1 WELDING OPERATIONS

##### 3.1.1 Requirements

Workmanship and techniques for welded construction shall conform to the requirements of AWS D1.1 and AISC-04. When AWS D1.1 and the AISC-04 specification conflict, the requirements of AWS D1.1 shall govern.

##### 3.1.2 Identification

Welds shall be identified in one of the following ways:

a. Written records shall be submitted to indicate the location of welds made by each welder, welding operator, or tacker.

b. Each welder, welding operator, or tacker shall be assigned a number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. For seam welds, the identification mark shall be adjacent to the weld at 3-foot intervals. Identification with die stamps or electric etchers shall not be allowed.

#### 3.2 QUALITY CONTROL

Testing shall be done by an approved inspection or testing laboratory or technical consultant, or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. The Contractor shall perform visual inspection to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Procedures and techniques for inspection shall be in accordance with applicable requirements of AWS D1.1.

#### 3.3 STANDARDS OF ACCEPTANCE

Dimensional tolerances for welded construction, details of welds, and quality of welds shall be in accordance with the applicable requirements of AWS D1.1 and the contract drawings. Nondestructive testing shall be by visual inspection methods. The minimum extent of nondestructive testing shall be random 50 percent of welds or joints, as indicated on the drawings.

### 3.3.1 Nondestructive Examination

The welding shall be subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop will not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment.

### 3.3.2 NOT USED

## 3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The costs of such inspection and testing will be borne by the Contractor if unsatisfactory welds are discovered, or by the Government if the welds are satisfactory. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

## 3.5 CORRECTIONS AND REPAIRS

When inspection or testing indicates defects in the weld joints, the welds shall be repaired using a qualified welder or welding operator as applicable. Corrections shall be in accordance with the requirements of AWS D1.1 and the specifications. Defects shall be repaired in accordance with the approved procedures. Defects discovered between passes shall be repaired before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, the affected area shall be blended into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before rewelding, the area shall be examined by suitable methods to insure that the defect has been eliminated. Repair welds shall meet the inspection requirements for the original welds. Any indication of a defect shall be regarded as a defect, unless reevaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

-- End of Section --

## SECTION C-05061

### ULTRASONIC INSPECTION OF WELDMENTS

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

- ASNT-01 (1996) Recommended Practice SNT-TC-1A
- ASNT-04 (1994) Question and Answer Book C: Ultrasonic Testing Method; Levels I, II, III (Supplement to Recommended Practice SNT-TC-1A)

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM E 165 (1995) Liquid Penetrant Examination
- ASTM E 709 (1995) Magnetic Particle Examination

##### AMERICAN WELDING SOCIETY (AWS)

- AWS D1.1 (1994) Structural Welding Code - Steel

##### 1.2 DEFINITIONS

###### 1.2.1 A Scan

Method of data presentation on a cathode ray tube using rectangular coordinates in which a horizontal base line indicates elapsed time when reading from left to right. A vertical deflection in the base line indicates reflect signal amplitude.

###### 1.2.2 Acoustically Similar Material

Material the same as that to be inspected; or another material proven to have acoustical velocity within plus or minus 3 percent and an attenuation within plus or minus 0.25 dB/inch of the inspected material for the inspection frequency and wave mode, using the same mode as that to be used for inspection.

###### 1.2.3 Amplitude

When referring to an indication in A scan presentation, amplitude is the vertical height of the indication measured from peak-to-peak for radio frequency indications and trace-to-peak for video indications.

###### 1.2.4 Attenuation

Dissipation or loss of energy as ultrasonic vibrations travel through the material. Attenuation is caused almost entirely by scattering of the ultrasonic vibrations generated by the search unit.

###### 1.2.5 Attenuation-Correction Controls

Circuitry to provide a continuous increase in amplification with respect to time. This circuitry compensates for the reduction in sensitivity with depth as a result of sound beam divergence and its attenuation in material.

#### 1.2.6 Back Reflection or End Reflection

Reflection from the opposite side, end, or boundary of the material into which the ultrasonic energy was introduced.

#### 1.2.7 Calibrated Gain Control (Attenuator)

Circuitry with which gain can be reduced finite amounts by switching electrical signal attenuation into the circuit.

#### 1.2.8 Calibration

Process of comparing an instrument or device with a standard to determine accuracy or produce a scale.

#### 1.2.9 Cathode Ray Tube (CRT)

An electron tube in which a controlled beam of electrons from the cathode is used to produce an image on a fluorescent screen at the end of the tube.

#### 1.2.10 Couplant

Any material, usually a liquid or semiliquid, used between the search unit and the inspection surface to exclude air and to convey the ultrasonic vibrations between the search unit and the material being inspected.

#### 1.2.11 Damping Control

Control that varies the duration of transducer ringing.

#### 1.2.12 Decibel (dB)

Units for the logarithmic expression of the ratio of power levels. Power levels can be functions of voltage, current, or impedance, for example. Decibel units having no values of their own are only significant when a reference is stated, as 10 dB above one reference level or 6 dB below another reference level.

#### 1.2.13 Delay Control

Means of delaying the pattern obtained on the CRT.

#### 1.2.14 Discontinuity

Anything within a material that will cause a detectable interruption in an ultrasonic beam.

#### 1.2.15 Distance-Amplitude Correction Curve

Curve showing the relationship between signal amplitude and equal-sized reflecting surfaces at various distances from the transducer. Reference standards are used to obtain such curves.

#### 1.2.16 Dynamic Range

Ratio of maximum to minimum size of reflective areas that can be adequately distinguished on the CRT at a constant gain setting.

#### 1.2.17 Effective Depth of Penetration

Maximum depth at which the sensitivity is satisfactory for the quality of test desired.

#### 1.2.18 Examination

Within the context of this specification, is equivalent to the word "inspection."

#### 1.2.19 Gain Control

Circuitry designed into the ultrasonic system to vary reflection amplitude. This control is usually calibrated in decibels. It is also called the sensitivity control.

#### 1.2.20 Gross

Background displacement of the trace on the CRT from the established baseline due to the gain setting, the characteristics of the test equipment, or the material under examination.

#### 1.2.21 Hertz

One complete set of recurrent values of a periodic quantity comprises a cycle. In other words, any one set of periodic variations starting at one condition and returning once to the same condition is a cycle.

#### 1.2.22 Immersion Techniques

Test methods in which the part to be tested and the search units are immersed in water or other suitable liquid couplant. A mechanical device is used to firmly hold and direct the wave angle of the search unit. The search unit does not contact the item being inspected.

#### 1.2.23 Indication

Visual presentation on the cathode ray screen resulting from a sound beam reflection from a boundary surface or discontinuity.

#### 1.2.24 Initial Pulse Indication

Usually called the "initial pulse." A signal on the CRT screen marking the instant at which a voltage impulse is applied to the transmitting crystal. Its rising edge is frequently invisible due to the time lag in the probe shoe and the consequent necessity to ensure coincidence between the time base zero and the instant at which the transmitter pulse actually enters the material under test.

#### 1.2.25 Linearity

Property of an instrument revealed by a linear change in reflected signal or displacement. The vertical linearity is determined by plotting the change in ratios of signal amplitude from two adjacent reflections from an area of known size. The horizontal linearity is determined by plotting the distance the signal is displaced along the sweep against the change in material thickness or by noting the spacing of multiple back reflections.

#### 1.2.26 Longitudinal or Compressional Waves

Simple compression-rarefaction waves in which particle motion within a material is linear and in the direction of wave propagation. Also called straight beams, or compressional or normal waves.

#### 1.2.27 Longitudinal Wave Inspection

Ultrasonic technique, normally using straight beam methods, in which longitudinal waves are the dominant form.

#### 1.2.28 Mid-Screen Reflection

Reflection whose amplitude is equal to one-half the usable screen height on the CRT.

#### 1.2.29 Megahertz (MHz)

One million hertz per second frequency.

#### 1.2.30 NDT Level I

An NDT Level I individual should be qualified to properly perform specific calibrations, specific NDT, and specific evaluations for acceptance or rejection determinations according to written instructions and to record results.

#### 1.2.31 NDT Level II

An NDT Level II individual should be qualified to set up and calibrate equipment and to interpret and evaluate results with respect to applicable codes, standards, and specifications.

#### 1.2.32 NDT Level III

An NDT Level III individual should be capable of establishing techniques and procedures; interpreting codes, standards, specifications, and procedures; and designating the particular NDT methods, techniques, and procedures to be used.

#### 1.2.33 Node

Distance a shear wave travels in a straight line from the inspection surface before being reflected by the opposite surface.

#### 1.2.34 Pulse Repetition Rate

Number of spaced pulses of sound per second sent into the material being inspected.

#### 1.2.35 Range Control

Means of expanding the pattern obtained on the CRT so that any portion of the total distance being tested can be presented.

#### 1.2.36 Reference Reflector

Standard reflector 0.06 inch diameter reference hole in the IIW reference block. Other approved blocks may have a different diameter reflector.

#### 1.2.37 Reflector

Boundary, consisting of an opposite side, crack, or separation, or a distinct change in material such as slag or porosity that reflects the ultrasonic energy the same as a mirror reflects light.

#### 1.2.38 Refracted Waves

Waves that have undergone change of velocity and direction by passing from one material to another material with different acoustical properties. Refraction will occur wherever the angle of the incident wave to the interface is other than perpendicular.

#### 1.2.39 Rejectable Discontinuity (Defect)

Reflector large enough to produce a signal (decibel rating) that exceeds the reject/repair line.

#### 1.2.40 Resolution

Ability to clearly distinguish signals obtained from two reflective surfaces with a minimum separation distance. Near-surface resolution is the ability to clearly distinguish a signal from a reflector at a minimum distance under the contact or near surface without interference from the initial pulse signal. Far-surface resolution is the ability to clearly distinguish signals from reflectors displaced at minimum distances from the far or back surface when the sound beam is normal to that back surface.

#### 1.2.41 Ringing

Excitation in a transducer due to the application of a short pulse of high voltage.

#### 1.2.42 Scanning

Procedure of moving the search unit or units along a test surface to obtain complete inspection of the entire volume of a material being inspected. Preliminary scanning refers to a somewhat common practice of rapidly traversing a weld ultrasonically with a higher instrument gain or sensitivity level than will be used for the evaluation. It gives the operator an estimate of the welding quality and also makes all defects more prominent and less likely to be missed.

#### 1.2.43 Search Unit

Device containing a piezoelectric material used for introducing vibrations into a material to be inspected or for receiving the vibrations reflected from the material. The active element of the search unit is defined as the effective transmitting area. Search units are also called transducers or probes. They may be single or dual and contain one or two piezoelectric elements, respectively, for transmission and reception. The single search unit is sometimes enclosed in a transducer wheel or search unit wheel. The search unit may be manually handled and placed in direct contact with the material to be inspected or may be held in a fixture for immersion techniques.

#### 1.2.44 Sensitivity

Measure of the ultrasonic equipment's ability to detect discontinuities. Quantitatively, it is the level of amplification of the receiver circuit in the ultrasonic instrument necessary to produce the required indication on the scope from the reference hole in the reference block. Also see "Standard Reference Level."

#### 1.2.45 Shear Waves

Waves in which the particles within the material vibrate perpendicularly to the direction in which the wave travels or propagates. Also called transverse waves.

#### 1.2.46 Shear Wave Inspection

Inspection technique using shear waves in a material. The search unit is placed at an angle to the contact surface of the material so the resultant refracted sound is a shear wave at an angle to the normal.

#### 1.2.47 Standard Reference Level

Mid-screen height reflection when beaming at the 0.06 inch hole in the primary reference block or the reference hole in the secondary standard.

#### 1.2.48 Surface Waves

Waves that propagate along the surface of the material and penetrate it to only about 1/2-wavelength. Also known as Rayleigh waves.

#### 1.2.49 Test Frequency

Operating frequency in hertz per second of the search unit during period of activation. Frequency is usually expressed in megacycles per second or megahertz. The latter term has been adopted for international use and is preferred.

#### 1.2.50 Video Form

Type of signal presentation on a CRT in which only the upper half of the signal appears.

### 1.3 GENERAL REQUIREMENTS

The welds to be ultrasonically inspected in accordance with this Section include:

a. The weld connecting bracket to column in Buildings B & C. This bracket supports the beam which carries the bridge crane rail. All welds of all brackets to be ultrasonically inspected.

The procedures, methods, standards, and description of equipment specified herein shall be used for inspection of weldments. Ultrasonic inspections shall be made to detect the following defects:

- a. Cracks or crack-like faults.
- b. Root defects, including lack of penetration and fusion.
- c. Lack of fusion between passes on the sidewall.
- d. Porosity or inclusions and excessive undercutting.

### 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-08 Statements

Ultrasonic Inspection; FIO.

Procedures and Methods. The pulse echo contact method with an A scan presentation shall be used for the ultrasonic inspection of welded joints except that immersion techniques may be used for some applications when approved by the Contracting Officer. The Contractor shall provide a standard reference block and working standards as described in paragraph REFERENCE STANDARDS FOR EQUIPMENT, QUALIFICATIONS, AND CALIBRATION. The procedures to be used for personnel and equipment qualification, equipment calibration, and inspection, shall be submitted to the Contracting Officer at least 30 days prior to their intended use. Approval by the Government will in no way affect the obligation of the Contractor to employ qualified personnel, equipment, and procedures, and to perform the inspection as specified. The procedure description shall include the following:



- a. Couplant.
- b. Search unit characteristics including angle, size, shape, nominal frequency, type designation.
- c. Method and type of wave.
- d. Equipment and accessories including manufacturer, model number, date of manufacture, last date of calibration, and the manufacturer's electrical, physical, and performance specifications.
- e. Decibel (dB) compensation system for distance-amplitude correction.

#### SD-18 Records

Ultrasonic Inspection; FIO.

Reports containing the following information:

- a. Identification and Location of Inspected Item: Name and place of the inspected item, the person performing the inspection, and the date of inspection.
- b. Detail of Inspections: Details of methods, types of waves used, search units, frequencies, inspection equipment identification, and calibration data with enough information to permit duplication of the inspection at a later date.
- c. Response in Calibration: The response from the DSC or SC block used in calibration and for acceptance/rejection in terms of the response from the 0.06 inch reference hole in the standard IIW block (primary standard).
- d. Identification of Unacceptable Areas: Locations, dimensions, types, and area of unacceptable defects and discontinuities giving reflections over 50 percent of the reject/repair line. These may be noted on a sketch or marked-up drawing.
- e. Record of Repair Areas: A record of repaired areas shall be furnished as well as test results for the repaired areas.

### 1.5 WAVE TYPES

The types of waves and the conditions under which they shall be used are specified below:

#### 1.5.1 Shear Waves

Unless conditions prohibit, shear waves shall be used. A longitudinal wave procedure may be used instead, if approved by the Contracting Officer. Refracted waves between 40 degrees and 70 degrees shall be used except where different angles are indicated in approved procedures, such as for materials less than 1/2 inch thick, for materials with sound velocities greater than in steel, when the weldments are not readily accessible, or when existing backing rings or backing strips are not removed. For inspection of weldments containing backing rings or backing strips, the instrument shall be adjusted and the refracted angles shall be selected in a way to separate the weldment and the backing ring reflections. The search unit angle and the resulting shear wave angle in the material to be inspected shall be established by the Contractor for each application and this information shall be included in the procedure submitted for approval.

#### 1.5.2 Longitudinal Waves

When conditions prohibit the use of shear waves, longitudinal waves may be used. The procedure shall be specially developed to suit the application and shall have the prior approval of the Contracting Officer.

#### 1.6 CHANGES IN PROCEDURE

Should application of an approved procedure not provide for good resolution or adequate ultrasonic penetration in the items to be inspected (see paragraph EQUIPMENT QUALIFICATION REQUIREMENTS), changes in procedure or equipment such as frequency, pulse repetition rate, angle of search unit, couplant, or oscilloscope shall be made by the Contractor. Adequacy of the new procedure shall be demonstrated to the Contracting Officer. The Government reserves the right to require a change in test equipment during these tests if any of the following test system characteristics fall below the levels listed in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS: sensitivity, amplitude and distance linearity, signal-to-noise ratio, entry and back surface resolution and penetration.

#### 1.7 ULTRASONIC EQUIPMENT

The ultrasonic equipment shall conform to the requirements listed in AWS D1.1 Section Inspection, subsection Ultrasonic Equipment, with the following exceptions:

a. The ultrasonic test instruments shall be able to generate, receive, and to present pulses in the frequency range from 1 to 10 megahertz (MHz).

b. The horizontal linearity of the ultrasonic instrument shall be measured in accordance with paragraph EQUIPMENT QUALIFICATION REQUIREMENTS.

c. In addition to the resolution test specified in AWS D1.1, subsection Ultrasonic Equipment, both near- and far-surface resolution tests shall be conducted in accordance with the tests specified for these characteristics in the paragraph EQUIPMENT QUALIFICATION REQUIREMENTS.

#### 1.8 PERSONNEL QUALIFICATION AND REQUIREMENTS

##### 1.8.1 Personnel Qualification

The three levels of responsibility associated with ultrasonic inspection are defined in ASNT-01. For qualification to perform ultrasonic inspection, personnel shall be certified under ASNT-01 and ASNT-04 within a period of 1 year before the date of contract. Other qualification or certification may be accepted at the Contracting Officer's discretion. Personnel with only an operator or inspector trainee certification will not be considered qualified to pass judgement on the acceptability of inspected items, but may work under the direct supervision of a qualified ultrasonic inspector. Qualified ultrasonic inspectors shall be able to judge the acceptability of the item in accordance with paragraph ACCEPTANCE/REJECTION LIMITS.

##### 1.8.2 Examinations

If the Contracting Officer doubts an individual's ability as an operator, inspector, or supervisor, the individual shall be recertified in accordance with ASNT-01. At the option of the Government, the Contracting Officer may participate in administering the examination and in evaluating the results.

#### 1.9 REFERENCE STANDARDS FOR EQUIPMENT, QUALIFICATIONS, AND CALIBRATION

Reference standards shall be used to calibrate the inspection equipment, test its operating condition, and record the sensitivity or response of the equipment during the inspection in accordance with paragraph EQUIPMENT QUALIFICATION

REQUIREMENTS. The standards shall comprise a standard reference block and reference specimens as noted below.

#### 1.9.1 Standard Reference Block

The standard reference block or primary standard shall be provided by the Contractor and shall consist of the IIW block in AWS D1.1, Section Inspection, subsection Reference Standards. The standard reference block also shall be used in any reinspection on the same basis as the original inspection, even though the reinspection is to be performed by other ultrasonic instruments and accessories.

#### 1.9.2 Working Standards

The Contractor may use other recognized working standards detailed with the IIW block in AWS D1.1 such as the Sensitivity Calibration (SC) block. However, such blocks must be referenced to the IIW block as noted in paragraph SENSITIVITY CALIBRATION OF LONGITUDINAL AND ANGLE WAVE SYSTEMS. Details of their use must be included in the procedure description submitted to the Contracting Officer. These blocks are the secondary standards. They shall be of acoustically similar material to the welds to be inspected. The secondary standards shall be suited for the applicable tests specified in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS and shall be used as follows, except where the IIW block is specifically required:

- a. To assure adequate penetration of the base material.
- b. To provide a secondary field standard.
- c. To calibrate the equipment and establish the standard reference level.

#### 1.9.3 Resolution Test Block

The Contractor shall furnish a resolution test block in accordance with the details shown in AWS D1.1 Section Inspection, subsection Ultrasonic Equipment.

### 1.10 EQUIPMENT QUALIFICATION REQUIREMENTS

The ultrasonic instrument and accessories shall be evaluated on their arrival at the jobsite just before the start of inspection. They shall be evaluated using the Contractor's furnished primary standard and shall meet or exceed the requirements listed in paragraphs under EQUIPMENT QUALIFICATION REQUIREMENTS. Equipment that does not meet these requirements shall not be used in the inspection.

#### 1.10.1 Requalifications

The equipment shall be requalified after normal use at intervals not to exceed 40 hours except as noted. The equipment also shall be requalified immediately after maintenance or repair or when the Contracting Officer considers its operation questionable.

#### 1.10.2 Longitudinal Wave System

##### 1.10.2.1 Vertical Amplitude Linearity

Two adjacent reflections of different amplitudes obtained through the thickness of the primary or secondary standard shall vary in the same proportion as the amplitude of the first reflection is increased in discrete 2-dB increments between 20 percent and 80 percent to full screen height. For each gain setting, the amplitude of each reflection shall vary by the same factor within plus or minus 5 percent. Requalification is required monthly or as otherwise stated in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS.

#### 1.10.2.2 Horizontal Linearity

The first three multiple reflections obtained through the thickness of the primary or secondary standard shall be equally spaced within plus or minus 5 percent when spread over 90 percent of the sweep length. Requalification is required monthly or as otherwise stated in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS.

#### 1.10.2.3 Near-Surface Resolution

Excessive ringing that appears on the CRT to the right of the sound entry point is not to exceed a 1/2 inch equivalent distance in steel with the search unit placed on the 4 inch edge of the IIW (primary) block and positioned for maximum amplitude reflection from the 0.06 inch reference hole of the primary standard. The reference reflector shall be set to mid-screen and the gain shall be increased 20 dB. The reference hole located at least 1/2 inch from one edge of the AW DSC or SC secondary standard shall be used similarly. Acceptability shall be on the same basis as in the primary standard.

#### 1.10.2.4 Far-Surface Resolution

This property of the equipment will be verified by the method detailed in AWS D1.1, Section Inspection, subsection Calibration of the Ultrasonic Unit with the IIW or Other Approved Calibration Blocks. In addition, the trailing edge of the third reflection shall return to the sweep line and be clearly discernible.

### 1.10.3 Angle Wave System

#### 1.10.3.1 Vertical (Amplitude) Linearity

Two adjacent multiple reflections from the 0.06 inch reference hole in the primary standard shall vary in the same proportion as the amplitude of the first reflection in discrete 2-dB increments between 20 percent and 80 percent of full screen height. For each gain setting, the amplitude of each adjacent reflection shall vary within plus or minus 5 percent. For testing with the AWS SC or AWS DSC secondary standard, the same criteria shall apply. For the SC block, the transducer shall be placed on the longitudinal surface contiguous with the sound entry point lines whereas the 4 inch longitudinal surface of the DSC block shall be used for the same purpose. Requalification is required monthly or as otherwise stated in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS.

#### 1.10.3.2 Horizontal Linearity

The first three multiple echoes obtained from the 0.06 inch reference hole of the primary standard or from the reference hole in a secondary standard with the transducer positioned at a minimum of 1 inch sound path distance shall be equally spaced plus or minus 5 percent when spread over 90 percent of the sweep length. The gain shall be adjusted to give a mid-screen height first reflection. Requalification is required monthly or as otherwise stated in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS.

#### 1.10.3.3 Near-Surface Resolution

The search unit shall be positioned for maximum amplitude using the primary or secondary standard as in the horizontal linearity test. The gain shall be adjusted to give a mid-screen height first reflection and then shall be increased 20 dB. Excessive ringing that appears on the CRT to the right of the sound entry point is not to exceed 1/2 inch equivalent distance in steel.

#### 1.10.3.4 Far-Surface Resolution

The equipment shall delineate the three resolution holes in the resolution block appropriate for the angle of the transducer to be used in the inspection.

#### 1.10.3.5 Signal-to-Noise Ratio

With the search unit located as in the horizontal linearity test, the gain shall be set to obtain an 80 percent full screen height first reflection. The reference reflection-to-noise-amplitude ratio shall not be less than 10 to 1.

#### 1.10.3.6 Exit Point

The search unit shall be placed on the graduated scale on the 12 inch edge of the primary standard and the ultrasound shall be beamed toward the curved edge of the block. The gain shall be set for a mid-screen first reflection. The search unit shall be moved back and forth until the first reflection is maximized. The index line on the side of the search unit shall be within 1/16 inch of the mid-point of the graduated scale in either direction. Requalification is required after 40 hours or as otherwise stated in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS.

#### 1.10.3.7 Transducer Angle

The established exit point of the probe shall be set over the applicable angle index line scribed on the 8 inch or 12 inch edge, as appropriate, of the primary standard. The gain shall be set to obtain a mid-screen first reflection from the 2-inch plexiglass-lined hole for search units up to 70 percent with the search unit placed on the 8 inch edge. Search units of large angles that have been approved specifically by the Contracting Officer shall be tested from the 12 inch edge using the 0.06 inch reference hole. The search unit shall be moved back and forth to maximize the first reflection. When the material to be inspected is not acoustically similar to the primary standard, the inspection angle shall be within plus or minus 2 degrees of the angle specified in the approved procedure. Requalification is required after 40 hours or as otherwise stated in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS.

### 1.11 SENSITIVITY CALIBRATION OF LONGITUDINAL AND ANGLE WAVE SYSTEMS

Sensitivity calibration shall be done immediately after a change of operators and at least every 30 minutes thereafter as testing proceeds. Recalibration shall also be required after any power interruption, including a change of source, when the equipment is suspected of being in error, or after relocation of the jobsite. The 30-minute and relocation calibrations may coincide. Before calibration, the instrument shall be allowed to warm up before calibration is attempted. The instrument range and delay controls shall be adjusted to display signals from the reference hole in the primary (IIW block) or secondary standard (DSC or SC block or both) on the viewing screen for the range of distances to be inspected.

#### 1.11.1 Calibration Procedure

The test instrument shall be calibrated as described below.

##### 1.11.1.1 Longitudinal Wave System

In calibrating with the primary standard, the transducer shall be positioned on the 4 inch edge for maximum reflection from the 0.06 inch reference hole. The gain shall be adjusted so that the first reflection is at 50 percent full scale. The top of that indication shall be marked on the CRT with a wax pencil or by other means. This establishes the standard reference level. A point at 80 percent of the standard reference level shall be calculated and marked. This locates the reject/repair line. If a secondary standard is to be used in the inspection, the reject/repair line will be established similarly. For the DSC block, the transducer shall be positioned on the 4 inch long surface and with the

SC degrees sound entry point lines. Adjustment for loss of signal due to distance shall be compensated for as noted in paragraph SENSITIVITY CALIBRATION OF LONGITUDINAL AND ANGLE WAVE SYSTEMS.

#### 1.11.1.2 Angle Wave System

In calibrating with either the primary or secondary standard, the transducer shall be positioned on the same surfaces as in the case of the longitudinal wave system but over the sound entry point lines appropriate for the angle of the transducer to be used in the inspection. The gain shall be adjusted to give a first reflection that is 50 percent of full-scale response. The top of that indication shall be marked with a wax pencil or by other means. This establishes the standard reference level. A point at 80 percent of the standard reference level shall be calculated and marked. This locates the reject/repair line. Loss of signal shall be compensated as noted in paragraph SENSITIVITY CALIBRATION OF LONGITUDINAL AND ANGLE WAVE SYSTEMS.

#### 1.11.2 Calibration of the Secondary Standards

After adjusting the first reflection from the reference hole in the secondary standard to 50 percent full-scale response for a shear or longitudinal wave inspection, a maximized reflection from the 0.06 inch reference hole in the primary standard shall be obtained without changing the gain setting. Then this gain setting shall be readjusted to obtain a 50 percent full-scale reflection and the readjusted setting shall be recorded as required by paragraph SUBMITTALS, Records, to provide a basis for recalibration when the secondary standard is unavailable.

#### 1.11.3 Equipment With a Calibrated Gain Control (Attenuator)

When a calibrated gain control attenuator is used, the transducer shall be positioned for a maximum reflection from the reference hole in the secondary standard representing approximately 1/2 the longest inspection distance. This reflection shall be adjusted to mid-scale by varying the gain control accordingly. The difference in decibels between this amplitude and the signal obtained from the first, second, and longest distance reflection obtainable on the secondary standard shall be measured. The differences shall be recorded and plotted on a curve to determine the necessary correction to the amplitude at the various inspection distances. A level (80 percent of the primary level) obtained from the corrected signal heights is equivalent to the reject/repair line.

#### 1.11.4 Equipment With Electronic Distance Compensation Circuitry

If the difference in amplitude between the first reflection and the reflection obtained from the maximum inspection distance is 1 dB or less, the instrument may be used as is. If not, the procedure used for equipment with a calibrated decibel control must be used to determine the necessary correction to the reflections obtained at the various inspection distances. This characteristic of the equipment must be reexamined on a monthly basis or as otherwise stated in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS and correction factors must be modified accordingly.

#### 1.11.5 Longitudinal Wave Distance-Amplitude Correction Curve

A distance-amplitude correction curve may be used instead of the calibrated gain control or the electronic circuitry for either the shear or longitudinal wave system as described below:

a. A shear wave distance-amplitude correction curve shall be constructed and drawn on the face of the cathode ray tube (CRT) for inspection of weldments in excess of 1-1/2 inch thick when the design of the test equipment permits. The reference hole in the secondary standard SC or DSC shall be used to construct the

distance-amplitude correction curve for a minimum of three node points, 1, 2, and 3. The sensitivity of the instrument shall be adjusted to produce 50 percent full-scale response for the maximized primary reflection and the reject/repair line shall be constructed at 80 percent of the established distance-amplitude curve.

b. A longitudinal wave distance-amplitude correction curve shall be constructed and drawn on the face of the CRT when longitudinal waves are to be used in the inspection for material thicknesses exceeding 1 inch, if design of the test equipment permits. The reference hole in the secondary standard shall be used. Instrument sensitivity shall be adjusted to 50 percent full-scale of the maximized response from the reference hole at 1/2-maximum inspection distance. A reject/repair line shall be constructed at 80 percent of the established distance-amplitude curve. The reflection amplitudes to define this curve shall be taken from the faces of the secondary sensitivity standards which are 1 inch), and 1/2-maximum inspection distance, and the longest distance obtainable from the secondary standard, respectively, from the reference hole. When a correction curve cannot be drawn on the face of the CRT, one of the distance-amplitude correction methods noted above and submitted under the procedure description in accordance with paragraph GENERAL REQUIREMENTS shall be applied.

#### 1.11.6 Longitudinal Wave Inspections Using Immersion Technique

The reference hole in a secondary standard shall be used for each different inspection distance. Repair/reject limits shall be established by immersing both the search unit and secondary standard in the liquid bath in which the inspection is to be conducted. The procedure noted below shall be used:

a. The longitudinal waves from the search unit shall be directed toward the face of the secondary standard closest to the reference hole.

b. The search unit shall be positioned for maximum response. The amplitude of reflection shall be adjusted to 50 percent full-scale. The top of that indication shall be marked on the CRT with a wax pencil or by other means. This establishes the standard reference level. A point at 80 percent of the standard reference level shall be calculated and marked. This locates the reject/repair point. The above shall be repeated for each different surface-to-hole distance to establish the reject/repair line.

c. With the gain at the same setting and the primary standard and search unit in air, a maximized reflection shall be obtained from the 0.06 inch reference hole in the primary standard (IIW). Then, this gain setting shall be readjusted to obtain a 50 percent full-scale reflection. The readjusted setting shall be recorded as required by paragraph SUBMITTALS, Records, to provide a basis for recalibration when the secondary standard is unavailable.

### PART 2 PRODUCTS (Not Applicable)

### PART 3 EXECUTION

#### 3.1 PREPARATION OF MATERIALS FOR INSPECTION

Surfaces shall be free from the following:

##### 3.1.1 Weld Spatter

Spattering or any roughness that interferes with free movement of the search unit or impairs transmission of the ultrasonic vibrations.

##### 3.1.2 Irregularities

Those which could mask or be confused with defect indications.

#### 3.1.3 Weld Backing Strips

Strips that are not to remain in place shall be removed and all sharp edges and valleys shall be eliminated by grinding or other mechanical means.

#### 3.1.4 Dirt

All loose scale, rust, paint, and dirt shall be removed from the coupling surface.

### 3.2 INSPECTION PROCEDURE

When possible, all welds shall be examined from both sides of the weld and from one surface. If complete inspection cannot be accomplished from one surface, inspection shall be made from another surface that is part of the same joint. Preliminary scanning techniques using an increased instrument gain shall be used to locate possible defects. When possible, gain shall be increased to a minimum of twice (6 dB) the reference level setting. Final acceptance or rejection shall be evaluated with the equipment properly calibrated and the gain control set at the reference level. The reject/repair line shall be used to evaluate quality of the weld. If a periodic calibration check shows that the equipment is not operating properly or that the system's sensitivity has decreased more than 20 percent (2 dB) from the established sensitivity level, all welds inspected since the prior calibration shall be reexamined. If penetration of the shear waves is questionable, the angle search unit shall be placed in position on one side of the weldment with the waves directed through the weldment. A disconnected angle search unit, plastic or metal wedge or disk, or any good reflector shall be placed in the wave path of the search unit on the far side of the weld to reflect the sound. When good reflections cannot be obtained by either shear or longitudinal waves, the Contractor shall modify the procedures in accordance with paragraph GENERAL REQUIREMENTS.

#### 3.2.1 Test Frequency

The test frequency for ferrous materials shall be as specified in AWS D1.1, Section Inspection, subsection Ultrasonic Equipment, except for thicknesses below 1/2 inch, frequencies between 2.25 and 5 MHz may be used to obtain increased sensitivity. For materials that are difficult to penetrate, any frequency within the operating range of the equipment may be used. The effective depth of penetration and sound beam divergency shall be demonstrated to the Contracting Officer.

#### 3.2.2 Couplants

The choice of couplant is optional with the Contractor except as follows:

- a. The couplant shall be the same as that used for equipment qualification and calibration.

- b. Couplants that may corrode the reference standards and material being tested or leave objectionable residues shall not be used.

- c. Oils shall not be used in systems intended to handle liquid oxygen.

- d. Couplants shall be of the proper viscosity to give good coupling for the surface roughness.

#### 3.2.3 Shear Wave Inspection



Shear wave inspection shall be performed as follows: The search unit shall be placed on the contact surface at a distance from the weld equal to that used when calibrating the equipment.

#### 3.2.4 Longitudinal Flaws

To detect longitudinal flaws, the search unit shall be slowly moved toward and away from the weld far enough to cover its entire cross section, approximately 90 degrees to the weld centerline. The search unit shall be radially oscillated to the left and right, covering an angle of approximately 30 degrees. During the foregoing movement, the search unit shall be continually advanced parallel to the weld centerline. The rate of movement shall depend on the operator's ability to clearly see and identify all reflections. The amount of movement shall be calculated to insure that the inspection distance will be great enough to traverse the weld.

#### 3.2.5 Transverse Flaws

To detect transverse flaws when the welded surface is ground flush, the search unit shall be moved along the welded surface in each direction parallel to the centerline of the weld metal with the wave radiating parallel to the weld centerline. To detect transverse flaws when the welded surface is not ground flush, the search unit shall be moved parallel to the weld in each direction, on the adjacent base metal at the top of the weld, with the wave directed at an angle of 30 degrees to the weld centerline.

#### 3.2.6 Longitudinal Wave Inspection

This inspection shall be made as follows:

a. The search unit shall be placed on the contact surface with the wave directed in a straight line through any intervening base metal and through the weldment.

b. The search unit shall then be moved slowly in a direction parallel to the weld centerline and zigzagged across an area equivalent to the welded thickness to make sure that waves penetrate the entire welded cross section.

c. The rate of movement shall be dependent on the operator's ability to clearly see and identify all reflections.

### 3.3 GENERAL ACCEPTANCE/REJECTION REQUIREMENTS

Discontinuities shall be evaluated only when the ultrasonic equipment is calibrated properly. If discontinuities are detected, the sound beam shall be directed to maximize the signal amplitude. To determine the length of a discontinuity, the search unit shall be moved parallel to the discontinuity axis in both directions from the position of maximum signal amplitude. One-half the amplitude or a 6-dB increase in sensitivity from a point at which the discontinuity signal drops rapidly to the baseline shall be defined as the extremity of the discontinuity. At this point, the scanning surface shall be marked at the position indicated by the center of the transducer. This shall be repeated to determine the other extremity. The length of the discontinuity shall be defined as the distance between these two marks. For discontinuities with signal amplitudes exceeding full screen height, 50 percent of full screen shall be considered half-peak amplitude. At this point, the scanning surface shall be marked at the position indicated by the center of the transducer. This shall be repeated to determine the other extremity. The length of the discontinuity shall be defined as the distance between these two marks. The maximum signal amplitude, length, depth, and position within the inspection zone shall be determined and reported for discontinuities yielding a signal amplitude equal to or exceeding the reject/repair line. The minimum recordable length of a

discontinuity shall be 1/8 inch. When evaluating welds joining two members with different thicknesses at the weld, the thickness T shall be the lesser of the two thicknesses. The criteria for acceptance or rejection based on ultrasonic inspection will supplement a visual inspection. The sizes and surface conditions of the welds shall conform to the requirements indicated on the applicable plans and drawings and other sections of the specification.

### 3.3.1 Investigation of Questionable Indications

An indication considered doubtful shall be brought to the attention of the Contracting Officer and, at the Contractor's option, the weld shall be repaired or investigated further. Indications detected within 3/8 inch of accessible surfaces shall be investigated further using liquid penetrant in accordance with ASTM E 165 or magnetic particle methods in accordance with ASTM E 709, as applicable, to determine if the surface is penetrated. Failure to locate the flaws by one of these methods shall necessitate further investigation by the other. Other questionable defects shall be further investigated using modifications of the inspection procedure in accordance with paragraph GENERAL REQUIREMENTS.

### 3.3.2 Inspection of Repairs

All repairs shall undergo the same inspection procedure that originally revealed the discontinuities. Before acceptance, the welds shall meet the standards required for the original weld.

## 3.4 ACCEPTANCE/REJECTION LIMITS

Welds shall be accepted or rejected by ultrasonic indication in accordance with the following:

### 3.4.1 Full Penetration Butt Welds and Corner Welds

#### 3.4.1.1 Not Used

#### 3.4.1.2 Class II

Welds shall be rejected on the basis of the following:

a. Any evidence of a crack, including those revealed by dye penetrant or magnetic particle inspection in accordance with paragraph GENERAL ACCEPTANCE/REJECTION REQUIREMENTS.

b. Any discontinuity with a reflection exceeding the established reject/repair line and with a length exceeding 1/4 inch. Adjacent discontinuities separated by sound metal with the dimension less than twice the length of the longest discontinuity shall be considered a single discontinuity.

c. Any discontinuity with a reflection equal to or exceeding 50 percent of the reject/repair line up to and including the reject/repair line shall be rejected if the discontinuity length exceeds T. In no case shall any single discontinuity length exceed 1-1/2 inches.

d. Adjacent discontinuities separated by sound metal with the dimension less than twice the length of the longest discontinuity shall be considered a single discontinuity. The maximum distance between the outer extremities of any two adjacent discontinuities or the sum of their lengths, whichever is greater, shall not exceed the length as specified above.

e. If the total cumulative length of discontinuities in any 12 inches of weld length exceeds 2 T, that weld length shall be rejected.

3.4.1.3 Not Used.

#### 3.4.2 Full Penetration Tee Welds

Full Penetration Tee Welds (for Incomplete Root Penetration): Any discontinuity with the reflection exceeding the established reject/repair line of the applicable class shall be rejected. Any discontinuity with a reflection exceeding 25 percent of the established reject/repair line up to and including the reject/repair line shall be rejected if its length exceeds  $1/2 T$  in a direction transverse to the axis of the weld or LT parallel to the axis for all classes. If the total cumulative length of discontinuities in any 12 inches of weld length exceeds the limits of the applicable class, that weld length shall be rejected.

#### 3.4.3 Partial and Full Penetration Tee Welds

Partial and Full Penetration Tee Weld Boundaries: The depth of weld penetration and weld cross section width at the through member surface shall be as indicated by applicable plans or drawings. Limits of discontinuities shall be as specified in preceding paragraphs.

#### 3.4.4 Tee Weld Discontinuities

Such discontinuities extending into the through member shall be rejected if reflection exceeds the established reject/repair line.

--END OF SECTION--

SECTION C-05120

STRUCTURAL STEEL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC ASD Manual (1989) Manual of Steel Construction Allowable Stress Design

AISC ASD/LRFD Vol II (1992) Manual of Steel Construction Vol II: Connections

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 6/A 6M (1996b) General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

ASTM A 36/A 36M (1996) Carbon Structural Steel

ASTM A 53 (1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 307 (1994) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A 325 (1996) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

ASTM A 500 (1993) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A 563 (1994) Carbon and Alloy Steel Nuts

ASTM F 436 (1993) Hardened Steel Washers

ASTM F 844 (1990) Washers, Steel, Plain (Flat), Unhardened for General Use

ASTM F 959 (1996) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B46.1 (1995) Surface Texture (Surface Roughness, Waviness, and Lay)

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (1993) Standard Symbols for Welding, Brazing and Nondestructive Examination

AWS D1.1 (1996) Structural Welding Code - Steel

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 25 (1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (without Lead and Chromate Pigments)

## 1.2 GENERAL REQUIREMENTS

Structural steel fabrication and erection shall be performed by an organization experienced in structural steel work of equivalent magnitude. The Contractor shall be responsible for correctness of detailing, fabrication, and for the correct fitting of structural members. Connections, for any part of the structure not shown on the contract drawings, shall be considered simple shear connections and shall be designed and detailed in accordance with pertinent provisions of AISC ASD Manual. Substitution of sections or modification of connection details will not be accepted unless approved by the Contracting Officer. AISC ASD Manual and AISC ASD/LRFD Vol II shall govern the work. Welding shall be in accordance with AWS D1.1 and Section 05055 WELDING, STRUCTURAL. High-strength bolting shall be in accordance with AISC ASD Manual.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

### SD-04 Drawings

Structural Steel System; GA.

Structural Connections; GA.

Shop and erection details including members (with their connections) not shown on the contract drawings. Welds shall be indicated by standard welding symbols in accordance with AWS A2.4.

### SD-08 Statements

Erection; FIO.

Prior to erection, erection plan of the structural steel framing describing all necessary temporary supports, including the sequence of installation and removal.

### SD-13 Certificates

Mill Test Reports; FIO.

Certified copies of mill test reports for structural steel, structural bolts, nuts, washers and other related structural steel items, including attesting that the structural steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation.

Fabrication; FIO.

A copy of the AISC certificate indicating that the fabrication plant meets the specified structural steelwork category.

### SD-14 NOT USED

## 1.4 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

## PART 2 PRODUCTS

## 2.1 STRUCTURAL STEEL

### 2.1.1 Carbon Grade Steel

Carbon grade steel shall conform to ASTM A 36/A 36M.

### 2.1.2 NOT USED

### 2.1.3 NOT USED

### 2.1.4 NOT USED

### 2.1.5 NOT USED

### 2.1.6 NOT USED

## 2.2 STRUCTURAL TUBING

Structural tubing shall conform to ASTM A 500, Grade B,  $F_y = 46$  ksi.

## 2.3 STEEL PIPE

Steel pipe shall conform to ASTM A 53, Type E, Grade B.

## 2.4 NOT USED

## 2.5 HIGH STRENGTH BOLTS AND NUTS

High strength bolts shall conform to ASTM A 325, Type 1 with carbon steel nuts conforming to ASTM A 563, Grade C or DH.

## 2.6 CARBON STEEL BOLTS AND NUTS

Carbon steel bolts shall conform to ASTM A 307, Grade A with carbon steel nuts conforming to ASTM A 563, Grade A.

## 2.7 NUTS DIMENSIONAL STYLE

Carbon steel nuts shall be Heavy Hex style when used with ASTM A 307 bolts or Heavy Hex style when used with ASTM A 325 bolts.

## 2.8 WASHERS

Plain washers shall conform to ASTM F 844. Other types, when required, shall conform to ASTM F 436 or ASTM F 959.

## 2.9 PAINT

Paint shall conform to SSPC Paint 25.

# PART 3 EXECUTION

## 3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC ASD Manual. Fabrication and assembly shall be done in the shop to the greatest extent possible. The fabricating plant shall be certified under the AISC quality certification program for Category I structural steelwork. Compression joints depending on contact bearing shall have a surface roughness not in excess of 500 micro inches as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A 6/A 6M. Structural steelwork, except surfaces of steel to be encased in concrete, surfaces to be field welded,

surfaces to be fireproofed, and contact surfaces of friction-type high-strength bolted connections shall be prepared for painting in accordance with AISC ASD Manual and primed with the specified paint.

### 3.2 ERECTION

Erection of structural steel shall be in accordance with the applicable provisions of AISC ASD Manual.

#### 3.2.1 Structural Connections

Anchor bolts and other connections between the structural steel and foundations shall be provided and shall be properly located and built into connecting work. Field welded structural connections shall be completed before load is applied.

#### 3.2.2 Base Plates and Bearing Plates

Column base plates for columns and bearing plates for beams, girders, and similar members shall be provided. Base plates and bearing plates shall be provided with full bearing after the supported members have been plumbed and properly positioned, but prior to placing superimposed loads. Separate setting plates under column base plates will not be permitted. The area under the plate shall be damp-packed solidly with bedding mortar. Bedding mortar and grout shall be as specified in Section C-03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

#### 3.2.3 Field Priming

After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

--END OF SECTION--

## SECTION C-05210

### STEEL JOISTS

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### STEEL JOIST INSTITUTE (SJI)

SJI-01 (1994) Standard Specifications Load  
Tables and Weight Tables for Steel Joists and  
Joist Girders

##### 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-04 Drawings

Steel Joists; GA.

Detail drawings shall include fabrication and erection details, specifications for shop painting, and identification markings of joists. Members and connections for any portion of the structure not shown on the contract drawings shall be designed and stamped by a registered professional engineer and detailed on the shop drawings. Design computations for all Contractor designed members and connections must accompany the shop drawings.

##### 1.3 DESCRIPTION

Steel joists are designated on the drawings in accordance with the standard designations of the Steel Joist Institute. Joists of other standard designations or joists with properties other than those shown may be substituted for the joists designated provided the structural properties are equal to or greater than those of the joists shown and provided all other specified requirements are met.

##### 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition and stored off the ground in a well drained location, protected from damage, and easily accessible for inspection and handling.

#### PART 2 PRODUCTS

##### 2.1 OPEN WEB STEEL JOISTS

Open web steel joists shall conform to SJI-01, K-Series. Joists shall be designed to support the loads given in the standard load tables of SJI-01.

##### 2.2 NOT USED

##### 2.3 NOT USED

##### 2.4 ACCESSORIES AND FITTINGS



Accessories and fittings, including end supports and bridging, shall be in accordance with the standard specifications under which the members were designed.

## 2.5 SHOP PAINTING

Joists and accessories shall be shop painted with a rust-inhibiting primer paint. For joists which will be finish painted under Section C-09900 PAINTING, GENERAL, the primer paint shall be limited to a primer which is compatible with the specified finish paint.

## PART 3 EXECUTION

### 3.1 ERECTION

Installation of joists shall be in accordance with the standard specification under which the member was produced. Joists shall be handled in a manner to avoid damage. Damaged joists shall be removed from the site, except when field repair is approved and such repairs are satisfactorily made in accordance with the manufacturer's recommendations. Joists shall be accurately set, and end anchorage shall be in accordance with the standard specification under which the joists were produced. Joist bridging and anchoring shall be secured in place prior to the application of any construction loads. Any temporary loads shall be distributed so that the carrying capacity of any joist is not exceeded. Loads shall not be applied to bridging during construction or in the completed work. Abraded, corroded, and field welded areas shall be cleaned and touched up with the same type of paint used in the shop painting.

### 3.2 BEARING PLATES

Bearing plates shall be provided with full bearing after the supporting members have been plumbed and properly positioned, but prior to placing superimposed loads. The area under the plate shall be damp-packed solidly with bedding mortar, except where nonshrink grout is indicated on the drawings. Bedding mortar and grout shall be as specified in Section 03300 CONCRETE FOR BUILDING CONSTRUCTION.

-- End of Section --

## SECTION C-05300

### STEEL DECKING

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC-04 (1989) Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design

##### AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI-01 (1986; Addenda 1989) Cold-Formed Steel Design Manual

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 108 (1995) Steel Bars, Carbon, Cold Finished, Standard Quality

ASTM A 570 (1995) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality

ASTM A 611 (1994) Steel, Sheet, Carbon, Cold-Rolled, Structural Quality

ASTM A 653 (1995) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy coated (Galvannealed) by the Hot-Dip Process

ASTM A 780 (1993a) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings

ASTM A 792 (1995) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process, General Requirements

##### AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 (1994) Structural Welding Code - Steel

AWS D1.3 (1989) Structural Welding Code - Sheet Steel

##### STEEL DECK INSTITUTE (SDI)

SDI-02 (1987; Amended 1991) Diaphragm Design Manual

SDI Pub No 28 (1995) Design Manual for Composite Decks, Form Decks, Roof Decks, and Cellular Metal Floor Deck with Electrical Distribution

##### STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 20 (1991) Zinc-Rich Primers (Type I - Inorganic and Type II-Organic)

##### 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

#### SD-01 Data

Deck Units; FIO.

Design computations for the structural properties of the deck units or SDI certification that the units are designed in accordance with SDI specifications.

#### SD-04 Drawings

Deck Units; GA.

Accessories; GA.

Attachments; GA.

Holes and Openings; GA.

Drawings shall include type, configuration, structural properties, location, and necessary details of deck units, accessories, and supporting members; size and location of holes to be cut and reinforcement to be provided; location and sequence of welded connections; and the manufacturer's erection instructions.

#### SD-13 Certificates

Deck Units; FIO.

Manufacturer's certificates attesting that the decking material meets the specified requirements.

#### SD-14 Samples

Roof Deck Units; GA.

Accessories; GA.

A 2 sq. ft. sample of the roof decking material to be used, along with a sample of each of the accessories used.

#### SD-18 NOT USED

### 1.3 DELIVERY, STORAGE, AND HANDLING

Deck units shall be delivered to the site in a dry and undamaged condition, stored off the ground with one end elevated, and stored under a weathertight covering permitting good air circulation. Finish of deck units shall be maintained at all times by using touch-up paint whenever necessary to prevent the formation of rust.

## PART 2 PRODUCTS

### 2.1 DECK UNITS

Deck units shall conform to SDI Pub No 28. Panels of maximum possible lengths shall be used to minimize end laps. Fabricate deck units in lengths to span 3 or more supports with flush, telescoped, or nested 2 inch laps at ends, and interlocking, or nested side laps, unless otherwise indicated. Deck with cross-sectional configuration differing from the units indicated may be used, provided that the properties of the proposed units, determined in accordance with AISI-01,

are equal to or greater than the properties of the units indicated and that the material will fit the space provided without requiring revisions to adjacent materials or systems.

#### 2.1.1 Roof Deck

Steel roof deck welded to bar joists and used in conjunction with SSMRS shall conform to ASTM A 653, ASTM A 611 or ASTM A 792. Roof deck units shall be standard 1-1/2" narrow rib type and shall be fabricated of 0.0358 inch design thickness or thicker steel and shall be zinc-coated in conformance with ASTM A 653, G90 coating class or aluminum-zinc coated in accordance with ASTM A 792 Coating Designation AZ55. The bottom (exposed) face of the deck shall be painted in accordance with Section 09900 PAINTING, GENERAL.

#### 2.1.2 NOT USED

#### 2.1.3 NOT USED

#### 2.1.4 Form Deck

Deck used as a permanent form for concrete shall conform to ASTM A 653 or ASTM A 611. Deck used as a form for concrete shall be fabricated of 0.0295 inch design thickness or thicker steel, and shall be zinc-coated in conformance with ASTM A 653, G60 coating class.

#### 2.1.5 NOT USED

#### 2.1.6 NOT USED

### 2.2 TOUCH-UP PAINT

Touch-up paint for zinc-coated units shall be an approved galvanizing repair paint with a high-zinc dust content. Welds shall be touched-up with paint conforming to SSPC Paint 20 in accordance with ASTM A 780. Finish of deck units and accessories shall be maintained by using touch-up paint whenever necessary to prevent the formation of rust.

### 2.3 ADJUSTING PLATES

Adjusting plates or segments of deck units shall be provided in locations too narrow to accommodate full-size units. As far as practical, the plates shall be the same thickness and configuration as the deck units.

### 2.4 CLOSURE PLATES

#### 2.4.1 Closure Plates for Roof Deck

Voids above interior walls shall be closed with sheet metal where shown. Open deck cells at parapets, end walls, eaves, and openings through roofs shall be closed with sheet metal. Sheet metal shall be same thickness as deck units.

#### 2.4.2 Closure Plates for Form Deck

The concrete shall be supported and retained at each floor level. Provide edge closures at all edges of the slab of sufficient strength and stiffness to support the wet concrete. Metal closures shall be provided for all openings in steel deck 1/4 inch and over, including but not limited to:

##### 2.4.2.1 Cover Plates to Close Panels

Cover plates to close panel edge and end conditions and where panels change direction or abut. Butt joints in steel deck may receive a tape joint cover.

#### 2.4.2.2 Column Closures to Close Openings

Column closures to close openings between steel deck and structural steel columns.

#### 2.4.2.3 Sheet Metal

Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck. Do not cut deck until after installation of supplemental supports.

### 2.5 ACCESSORIES

The manufacturer's standard accessories shall be furnished as necessary to complete the deck installation. Metal accessories shall be of the same material as the deck and have minimum design thickness as follows: other metal accessories, 0.0358 inch; unless otherwise indicated. Accessories shall include but not be limited to butt cover plates and underlapping sleeves, and ridge and valley plates.

## PART 3 EXECUTION

### 3.1 ERECTION

Erection of deck and accessories shall be in accordance with SDI Pub No 28 and the approved detail drawings. Damaged deck and accessories including material which is permanently stained or contaminated, with burned holes or deformed shall not be installed. The deck units shall be placed on secure supports, properly adjusted, and aligned at right angles to supports before being permanently secured in place. The deck shall not be filled with concrete, used for storage or as a working platform until the units have been secured in position. Loads shall be distributed by appropriate means to prevent damage during construction and to the completed assembly. The maximum uniform distributed storage load shall not exceed the design live load. There shall be no loads suspended directly from the steel deck.

### 3.2 NOT USED

### 3.3 ATTACHMENTS

All fasteners shall be installed in accordance with the manufacturer's recommended procedure, except as otherwise specified. The deck units shall be welded with nominal 5/8 inch diameter puddle welds to supports as indicated on the design drawings and in accordance with requirements of SDI Pub No 28. All welding of steel deck shall be in accordance with AWS D1.3 using methods and electrodes as recommended by the manufacturer of the steel deck being used. Welds shall be made only by operators previously qualified by tests prescribed in AWS D1.3 to perform the type of work required. Welding washers shall not be used at the connections of the deck to supports. Welding washers shall not be used at sidelaps. Holes and similar defects will not be acceptable. Deck ends shall be 2 inches. Sidelaps of the roof deck shall be fastened with self drilling #10 or larger screws as indicated on the design drawings. All partial or segments of deck units shall be attached to structural supports in accordance with Section 2.5 of SDI-02.

### 3.4 HOLES AND OPENINGS

All holes and openings required shall be coordinated with the drawings, specifications, and other trades. Holes and openings shall be drilled or cut, reinforced and framed as indicated on the drawings or described in the specifications and as required for rigidity and load capacity. Holes and openings less than 6 inches across require no reinforcement. Holes and openings

6 to 12 inches across shall be reinforced by 0.0474 inch thick steel sheet at least 12 inches wider and longer than the opening and be fastened to the steel deck at each corner of the sheet and at a maximum of 6 inches on center. Holes and openings larger than 12 inches shall be reinforced by steel angles installed perpendicular to the steel joists and supported by the adjacent steel joists. Steel angles shall be installed perpendicular to the deck ribs and shall be fastened to the angles perpendicular to the steel joists. Openings must not interfere with seismic members such as chords and drag struts.

3.5 NOT USED

--END OF SECTION--

## SECTION C-05500

### MISCELLANEOUS METAL

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1980; R 1993) Designation System for Aluminum Finishes

##### AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A14.3 (1992) Ladders - Fixed - Safety Requirements

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36 (1996) Structural Steel

ASTM A 53 (1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

ASTM A 123 (1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 283 (1993a) Low and Intermediate Tensile Strength Carbon Steel Plates

ASTM A 475 (1995) Zinc-Coated Steel Wire Strand

ASTM A 500 (1993) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A 653 (1996) Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process

ASTM A924 (1996a) Steel Sheet, Metallic-Coated by the Hot-Dip Process

##### AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 (1994) Structural Welding Code - Steel

##### 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Miscellaneous Metal Items; FIO.

Detail drawings indicating material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates. Detail drawings for the following items: FIO.

Handrails  
Ladders  
Partitions, diamond mesh type  
Roof scuttle  
Safety Nosing  
Steel stairs

SD-14 NOT USED

### 1.3 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM A 123, ASTM A 653, or ASTM A 924, as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

### 1.4 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

### 1.5 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

### 1.6 ANCHORAGE

Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; and lag bolts and screws for wood.

### 1.7 NOT USED

### 1.8 SHOP PAINTING

Surfaces of ferrous metal except galvanized surfaces, shall be cleaned and shop coated with the manufacturer's standard protective coating unless otherwise



specified. Surfaces of items to be embedded in concrete shall not be painted. Items to be finish painted shall be prepared according to manufacturer's recommendations or as specified.

## PART 2 PRODUCTS

### 2.1 THRU 2.6 NOT USED

### 2.7 PIPE GUARDS

Pipe guards shall be heavy duty steel pipe conforming to ASTM A 53, Type E or S, weight STD, black finish.

### 2.8 THRU 2.13 NOT USED

### 2.14 HANDRAILS

Handrails shall be designed to resist a concentrated load of 200 pounds in any direction at any point of the top of the rail or 20 pounds per foot applied horizontally to top of the rail, whichever is more severe.

#### 2.14.1 Steel Handrails, Including Carbon Steel Inserts

Steel handrails, shall be steel pipe conforming to ASTM A 53. Steel railings shall be 1-1/2 inch nominal size. Railings shall be hot-dip galvanized and shop painted.

a. Fabrication: Joint posts, rail, and corners shall be fabricated by one of the following methods:

(1) Flush type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 3/8 inch hexagonal recessed-head setscrews.

(2) Mitered and welded joints by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices shall be butted and reinforced by a tight fitting interior sleeve not less than 6 inches long.

(3) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

b. Removable sections, toe-boards, and brackets shall be provided as indicated.

#### 2.14.2 NOT USED

### 2.15 NOT USED

### 2.16 LADDERS

Ladders shall be galvanized steel, fixed rail type in accordance with ANSI A14.3.

### 2.17 NOT USED

### 2.18 NOT USED

### 2.19 MISCELLANEOUS

Miscellaneous plates and shapes for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous

mountings, and frames, shall be provided to complete the work. Steel lintels shall be galvanized in conformance with ASTM A123.

## 2.20 PARTITIONS, DIAMOND MESH TYPE

Partitions shall be constructed of metal fabric attached to structural steel framing members. Fabric shall be 10 gauge steel wires woven into 1-1/2 inch diamond mesh with wire secured through weaving channels. Framing members shall be channels 1-1/2 by 1/8 inch minimum size. Channel frames shall be mortised and tenoned at intersections. Steel frames, posts, and intermediate members shall be of the sizes and shapes indicated. Cast-iron floor shoes and caps shall have setscrew adjustment. Doors and grilles shall be provided as indicated, complete with hardware and accessories including sliding mechanisms, locks, guard plates, sill shelves and brackets, and fixed pin butts. Doors and grilles shall have cover plates as indicated. Locks shall be bronze, cylinder, mortise type. Keying shall be coordinated with Section C-08700 BUILDERS' HARDWARE. Ferrous metal portions of partitions and accessories shall be galvanized.

## 2.21 NOT USED

## 2.22 ROOF SCUTTLES

Roof scuttles shall be of galvanized steel not less than 14 gauge, with 3 inch beaded flange welded and ground at corners. Scuttle shall be sized to provide minimum clear opening of 36 by 36 inches. Cover and curb shall be insulated with 1 inch thick rigid insulation covered and protected by galvanized steel liner not less than 26 gauge. The curb shall be equipped with an integral metal cap flashing of the same gauge and metal as the curb, full welded and ground at corners for weathertightness. Scuttle shall be completely assembled with heavy hinges, compression spring operators enclosed in telescopic tubes, positive snap latch with turn handles on inside and neoprene draft seal. Fasteners shall be provided for padlocking on the inside. The cover shall be equipped with an automatic hold-open arm complete with handle to permit one hand release.

## 2.23 NOT USED

## 2.24 SAFETY NOSING

Safety nosings shall be of cast iron with plain, abrasive surface. Nosing shall be 3 inches wide and terminating at not more than 6 inches from the ends of treads, except nosing for metal pan cement-filled treads shall extend the full length of the tread. Safety nosings shall be provided with anchors not less than 3/4 inch long. Integrally cast mushroom anchors are not acceptable.

## 2.25 NOT USED

## 2.26 STEEL STAIRS

Steel stairs shall be complete with structural or formed channel stringers, metal pan cement-filled treads, landings, handrails, and necessary bolts and other fastenings as indicated. Structural steel shall conform to ASTM A 36. Risers on stairs with metal pan treads shall be deformed to form a sanitary cove to retain the tread concrete. Integral nosings shall have braces extended into the concrete fill.

## 2.27 NOT USED

## 2.28 TRENCH FRAMES AND COVERS

Trench frames and anchors shall be cast iron designed to match cover. Covers shall have flush drop handles formed of 1/4 inch round stock, and shall be

raised-tread cast-iron grating. Frame and cover shall be "heavy duty" type certified to support 16,000 pound minimum wheel loads.

2.29 THRU 2.33 NOT USED

### PART 3 EXECUTION

#### 3.1 GENERAL REQUIREMENTS

All items shall be installed at the locations shown and according to the manufacturer's recommendations. Items listed below require additional procedures as specified.

3.2 NOT USED

3.3 NOT USED

3.4 NOT USED

#### 3.5 INSTALLATION OF PIPE GUARDS

Pipe guards shall be set vertically in concrete piers. Piers shall be constructed of, and the hollow cores of the pipe filled with, concrete having a compressive strength of 3000 psi.

3.6 NOT USED

#### 3.7 ATTACHMENT OF HANDRAILS

Toeboards and brackets shall be installed where indicated. Splices, where required, shall be made at expansion joints. Removable sections shall be installed as indicated.

##### 3.7.1 Installation of Steel Handrails

Installation shall be by means of pipe sleeves secured with expansion shields and bolts or toggle bolts or base plates bolted to stringers or structural steel framework. Rail ends shall be secured by steel pipe flanges anchored by expansion shields and bolts.

3.7.2 NOT USED

3.8 NOT USED

3.9 NOT USED

#### 3.10 PARTITION POSTS AND OPENINGS

Posts shall be set in shoes bolted to the floor and in caps tap-screwed to clip angles in overhead construction, as indicated. Openings shall be formed using channels similar to the partition frames at ducts, pipes, and other obstructions.

3.11 NOT USED

3.12 NOT USED

#### 3.13 INSTALLATION OF SAFETY NOSINGS

Nosing shall be completely embedded in concrete before the initial set of the concrete occurs and shall finish flush with the top of the concrete surface.

3.14 NOT USED

3.15 TRENCH FRAMES AND COVERS

Trench frames and covers shall finish flush with the floor.

3.16 NOT USED

3.17 NOT USED

3.18 NOT USED

3.19 NOT USED

-- End of Section --

SECTION C-06100

ROUGH CARPENTRY

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN FOREST AND PAPER ASSOCIATION (AFPA)

- |               |  |
|---------------|--|
| AFPA-T901     | (1991; Supple 1993; Addenda Apr. 95) National Design Specification for Wood Construction |
| AFPA T11-WCD1 | (1988) Manual for Wood Frame Construction  |

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |            |  |
|------------|--|
| ASTM A 307 | (1994) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength   |
| ASTM C 518 | (1991) Steady-State Heat Flux Measurements and Thermal Transmission Properties By Means of the Heat Flow Meter Apparatus |
| ASTM C 665 | (1994) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing                    |

AMERICAN WOOD PRESERVERS' ASSOCIATION (AWPA)

- |         |   |
|---------|---|
| AWPA C2 | (1995) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes |
| AWPA P5 | (1996) Standards for Waterborne Preservatives   |

CALIFORNIA REDWOOD ASSOCIATION (CRA)

- |        |  |
|--------|--|
| CRA-01 | (1995) Standard Specifications for Grades of California Redwood Lumber |
|--------|--|

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

- |         |   |
|---------|---|
| NHLA-01 | (1994) Rules for the Measurement & Inspection of Hardwood & Cypress |
|---------|---|

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

- |          |   |
|----------|---|
| NELMA-01 | (1993) Standard Grading Rules for Northeastern Lumber |
|----------|---|

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

- |         |   |
|---------|---|
| SCMA-01 | (1986; Supple No. 1, Aug 1993) Standard Specifications for Grades of Southern Cypress |
|---------|---|

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB-1001 (1994) Standard Grading Rules for  
Southern Pine Lumber

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB Std 17 (1993; Supples III(A), V(A), & VI(A)) Grading Rules  
for West Coast Lumber

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA-01 (1995; Supple Nos. 1, 2 and 3) Western Lumber  
Grading Rules 91

1.2 NOT USED

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well ventilated areas, and protected from extreme changes in temperature and humidity.

PART 2 PRODUCTS

2.1 LUMBER AND SHEATHING

2.1.1 Grading and Marking

2.1.1.1 Lumber Products

Solid sawn and finger-jointed lumber shall bear an authorized gradestamp or grademark recognized by ALSC, or an ALSC recognized certification stamp, mark, or hammerbrand. Surfaces that are to be exposed to view shall not bear grademarks, stamps, or any type of identifying mark.

2.1.1.2 NOT USED

2.1.1.3 NOT USED

2.1.2 Sizes

Lumber and material sizes shall conform to requirements of the rules or standards under which produced. Unless otherwise specified, lumber shall be surfaced on four sides. Unless otherwise specified, sizes indicated are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

2.1.3 Treatment

2.1.3.1 Lumber and Timbers

Lumber and timbers shall be treated in accordance with AWPA C2 with waterborne preservatives listed in AWPA P5 to a retention level as follows:

a. 0.25 pcf intended for above ground use.

b. 0.40 pcf intended for ground contact and fresh water use.

2.1.3.2 NOT USED

2.1.4 Moisture Content

At the time lumber and other materials are delivered and when installed in the work their moisture content shall be as follows:

a. Treated and Untreated Lumber:

4 inches or less, nominal thickness, 19 percent maximum.  
5 inches or more, nominal thickness, 23 percent maximum in a 3 inch perimeter of the timber cross-section.

b. NOT USED

c. Materials Other Than Lumber: In accordance with standard under which product is produced.

2.1.5 NOT USED

2.1.6 NOT USED

2.1.7 NOT USED

2.1.8 NOT USED

2.1.9 NOT USED

2.1.10 NOT USED

2.1.11 NOT USED

2.1.12 Miscellaneous Wood Members

2.1.12.1 Nonstress Graded Members

Members shall include furring, sleepers, and nailing strips. Members shall be in accordance with TABLE I for the species used. Sizes shall be as follows unless otherwise shown:

Member	Size (inch)
Furring	1 by 2.
Sleepers	2 by 4.
Nailing strips	1 by 3 or 1 by 4 when used as interior finish, otherwise 2 inch stock.

2.1.12.2 NOT USED

2.1.12.3 Sill Plates

Sill plates shall be standard or number 2 grade.

2.1.12.4 NOT USED

2.1.12.5 Rough Bucks and Frames

Rough bucks and frames shall be straight standard or number 2 grade.

2.2 ACCESSORIES AND NAILS

Markings shall identify both the strength grade and the manufacturer. Accessories and nails shall conform to the following:

#### 2.2.1 Anchor Bolts

ASTM A 307, size as indicated, complete with nuts and washers.

#### 2.2.2 Bolts: Lag, Toggle, and Miscellaneous Bolts and Screws

Type, size, and finish best suited for intended use. Finish options include zinc compounds, cadmium, and aluminum paint impregnated finishes.

#### 2.2.3 NOT USED

#### 2.2.4 NOT USED

#### 2.2.5 NOT USED

#### 2.2.6 NOT USED

#### 2.2.7 Nails and Staples

ASTM F 547, size and type best suited for purpose. In general, 8-penny or larger nails shall be used for nailing through 1 inch thick lumber and for toe nailing 2 inch thick lumber; 16-penny or larger nails shall be used for nailing through 2 inch thick lumber. Nails used with treated lumber shall be galvanized. Nailing shall be in accordance with the recommended nailing schedule contained in AFPA T11-WCD1. Where detailed nailing requirements are not specified, nail size and spacing shall be sufficient to develop an adequate strength for the connection. The connection's strength shall be verified against the nail capacity tables in AFPA-T901. Reasonable judgement backed by experience shall ensure that the designed connection will not cause the wood to split. If a load situation exceeds a reasonable limit for nails, a specialized connector shall be used.

#### 2.2.8 NOT USED

### 2.3 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown. R-values shall be determined at 75 degrees F in accordance with ASTM C 518. Insulation shall contain the highest practicable percentage of recovered material which has been recovered or diverted from solid waste, but not including material reused in a manufacturing process. Where two materials have the same price and performance, the one containing the higher recovered material content shall be provided. Insulation shall be the standard product of a manufacturer and factory marked or identified with manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Materials containing more than one percent asbestos will not be allowed.

#### 2.3.1 Batt

##### 2.3.1.1 NOT USED

##### 2.3.1.2 Mineral Fiber Batt

Mineral fiber batt shall conform to ASTM C 665, Type III foil faced insulation Class C.

##### 2.3.1.3 NOT USED

#### 2.3.2 NOT USED



### 2.3.3 Sill Sealer

Mineral wool, 1 inch thick and compressible to 1/32 inch, width of sill, designed to perform as an air, dirt, and insect seal in conformance with ASTM C 665, Type I.

### 2.3.4 NOT USED

### 2.4 NOT USED

### 2.5 NOT USED

## PART 3 EXECUTION

### 3.1 NOT USED

### 3.2 NOT USED

### 3.3 NOT USED

### 3.4 NOT USED

### 3.5 NOT USED

### 3.6 INSTALLATION OF MISCELLANEOUS WOOD MEMBERS

#### 3.6.1 NOT USED

#### 3.6.2 NOT USED

#### 3.6.3 NOT USED

#### 3.6.4 Nailers and Nailing Strips

Nailers and nailing strips shall be provided as necessary for the attachment of finish materials. Stacked nailers shall be assembled with spikes or nails spaced not more than 18 inches on center and staggered. Beginning and ending nails shall not be more than 6 inches for nailer end. Ends of stacked nailers shall be offset approximately 12 inches in long runs and alternated at corners. Anchors shall extend through the entire thickness of the nailer. Strips shall be run in lengths as long as practicable, butt jointed, and rigidly secured in place.

#### 3.6.5 Wood Grounds

Wood grounds shall be provided as necessary for attachment of lockers and other work to concrete. Grounds shall be run in lengths as long as practicable, butt jointed, and rigidly secured in place.

#### 3.6.6 Furring Strips

Furring strips shall be provided at the locations shown. Furring strips shall be installed at 16 inches on center unless otherwise shown, run in lengths as long as practicable, butt jointed and rigidly secured in place.

#### 3.6.7 Rough Bucks and Frames

Rough bucks shall be set straight, true, and plumb, and secured with anchors near top and bottom of each wood member and at intermediate intervals of not more than 3 feet. Anchors for concrete shall be expansion bolts, and anchors for masonry shall be 3/16 by 1-1/4 inch steel straps extending not less than 8 inches into the masonry and turned down 2 inches into the masonry.

3.6.8 NOT USED

3.6.9 Sill Plates

Sill plates shall be set level and square and anchor bolted at not more than 6 feet on centers and not more than 12 inches from end of each piece. A minimum of two anchors shall be used for each piece.

3.7 NOT USED

3.8 INSTALLATION OF INSULATION

Insulation shall be installed after construction has advanced to a point that the installed insulation will not be damaged by remaining work. For thermal insulation the actual installed thickness shall provide the R-values shown. Insulation shall be installed on the weather side of such items as electrical boxes and water lines. Unless otherwise specified, installation shall be in accordance with the manufacturer's recommendation.

3.9 NOT USED

3.10 NOT USED

TABLE I. SPECIES AND GRADE

Furring, Sleepers, Nailing Strips

Grading Rules	Species	Const Standard	No. 2 Comm	No. 2 Board Comm	No. 3 Comm
NHLA-01	Cypress			X	
NELMA-01	Northern White Cedar				X
	Eastern White Pine	X			
	Northern Pine	X			
	Balsam Fir				X
	Eastern Hemlock- Tamarack				X
CRA-01	Redwood		X		
SCMA-01	Cypress			X	
SPIB-01	Southern Pine		X		
WCLIB Std 17	Douglas Fir-Larch	X			
	Hem-Fir	X			
	Sitka Spruce	X			
	Mountain Hemlock	X			
	Western Cedar	X			
WWPA-01	Douglas Fir-Larch	X			
	Hem-Fir	X			
	Idaho White Pine	X			
	Lodgepole Pine			X	
	Ponderosa Pine			X	
	Sugar Pine			X	
	Englemann Spruce			X	
	Douglas Fir South			X	
	Mountain Hemlock			X	
	Subalpine Fir			X	
	Western Cedar			X	

TABLE II. SPECIES AND GRADE

Sill Plates, Rough Bucks and Frames

Grading Rules	Species	No. 1	No. 2
NHLA-01	Red Oak	X	
NELMA-01	Northern Pine		X
	Eastern Hemlock-		X
	Tamarack		
SPIB-1001	Southern Pine	X	
WCLIB Std 17	Douglas Fir-Larch		X
	Hem-Fir		X
WWPA-01	Douglas Fir-Larch		X
	Hem-Fir		X
	Douglas Fir-South		X
-- End of Section --			

## SECTION C-07270

### FIRESTOPPING

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 84	(1995a) Surface Burning Characteristics of Building Materials
ASTM E 814	(1994b) Fire Tests of Through-Penetration Fire Stops

##### UNDERWRITERS LABORATORIES (UL)

UL-05	(1995; Supple) Fire Resistance Directory
UL 723	(1993; Rev Apr 1994) Test for Surface Burning Characteristics of Building Materials
UL 1479	(1994) Fire Tests of Through-Penetration Firestops

##### 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-04 Drawings

Firestopping Materials; FIO.

Detail drawings including manufacturer's descriptive data, typical details, installation instructions and the fire-test data and/or report as appropriate for the fire resistance rated construction and location. Submittal shall indicate the firestopping material to be provided for each type of application. When more than 5 penetrations are to receive firestopping, drawings shall indicate location and type of application.

##### SD-13 Certificates

Firestopping Materials; FIO.

Certificates attesting that firestopping material complies with the specified requirements. The label or listing of the Underwriters Laboratories will be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing agency equipped to perform such services, stating that the items have been tested and conform to the specified requirements and testing methods.

Inspection; GA.

Manufacturer's representative certification stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

### 1.3 GENERAL REQUIREMENTS

Firestopping shall consist of furnishing and installing a material or a combination of materials to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint.

### 1.4 STORAGE AND DELIVERY

Materials shall be delivered in the original unopened packages or containers showing name of the manufacturer and the brand name. Materials shall be stored off the ground and shall be protected from damage and exposure to elements. Damaged or deteriorated materials shall be removed from the site.

### 1.5 INSTALLER QUALIFICATIONS

Installer of firestopping material shall be trained by the manufacturer or the manufacturer's representative, and shall have a minimum of 3 years experience in the installation of firestopping of the type specified.

## PART 2 PRODUCTS

### 2.1 FIRESTOPPING MATERIALS

Firestopping materials shall consist of commercially manufactured products complying with the following minimum requirements:

#### 2.1.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723. Material shall be an approved firestopping material as listed in UL-05.

#### 2.1.2 Toxicity

Material shall be nontoxic to humans at all stages of application.

#### 2.1.3 Fire Resistance Rating

Firestopping will not be required to have a greater fire resistance rating than that of the assembly in which it is being placed.

##### 2.1.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph GENERAL REQUIREMENTS, shall provide "F" and "T" fire resistance ratings in accordance with ASTM E 814 or UL 1479, except that T Ratings are not required for penetrations smaller than or equal to a 4-inch nominal pipe or 16 square inches in overall cross sectional area. Fire resistance ratings shall be the following:

a. Penetrations of Fire Resistance Rated Walls and Partitions: F Rating = 1 hour, T Rating = 2 hour.

b. Penetrations of Fire Resistance Rated Floors and Ceiling-Floor Assemblies; F Rating = 1 hour, T Rating = 1 hour.

#### 2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph GENERAL REQUIREMENTS, and gaps such as those between floor slabs or roof decks and curtain walls shall be the same as the construction in which they occur.

#### 2.1.4 NOT USED

### PART 3 EXECUTION

#### 3.1 PREPARATION

Areas to receive firestopping shall be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system.

#### 3.2 INSTALLATION

Firestopping material shall completely fill void spaces regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping for filling floor voids 4 inches or more in any direction shall be capable of supporting the same load as the floor is designed to support or shall be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Firestopping shall be installed in accordance with manufacturer's written instructions. Firestopping shall be provided in the following locations:

a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.

b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.

c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.

d. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.

e. Construction joints in floors and fire rated walls and partitions.

f. Other locations where required to maintain fire resistance rating of the construction.

#### 3.3 INSPECTION

Firestopped areas shall not be covered or enclosed until inspection is complete and approved. A manufacturer's representative shall inspect the applications initially to insure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements.

-- End of Section --

## SECTION C-07412

### NON-STRUCTURAL METAL ROOFING

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 463	(1996a) Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 653	(1996) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 792	(1995) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B 117	(1994) Operating Salt Spray (Fog) Testing Apparatus
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 518	(1991) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C 612	(1993) Mineral Fiber Block and Board Thermal Insulation
ASTM C 991	(1992) Flexible Glass Fiber Insulation for Pre-Engineered Metal Buildings
ASTM C 1289	(1995) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D 226	(1994) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 522	(1993a) Mandrel Bend Test of Attached Organic Coatings
ASTM D 523	(1989; R 1994) Specular Gloss
ASTM D 714	(1987; R 1994) Evaluating Degree of Blistering of Paints
ASTM D 968	(1993) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 1308	(1987; R 1993) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2244	(1993) Calculation of Color Differences from



#### Instrumentally Measured Color Coordinates

ASTM D 2247	(1994) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 2794	(1993) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(1995) Measuring Adhesion by Tape Test
ASTM D 4214	(1989) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4397	(1996) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 4587	(1991) Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water- Exposure Apparatus
ASTM E 84	(1996a) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials

#### UNDERWRITERS LABORATORIES (UL)

UL 580	(1998) Tests for Uplift Resistance of Roof Assemblies.
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### 1.2 GENERAL REQUIREMENTS

The Contractor shall furnish a manufacturer's standard product which satisfies the specified design and additional requirements contained herein. The roofing system shall be provided by the Contractor as a complete system as tested and approved in accordance with UL-580. Roof panels, components, transitions, accessories, and assemblies shall be supplied by the same roofing system manufacturer.

#### 1.2.1 Non-Structural Metal Roof System (Buildings B, C and D)

The Non-Structural Metal Roof System covered under this specification shall include the entire roofing system; the standing seam metal roof panels, fasteners, connectors, roof securement components, and assemblies tested and approved in accordance with UL 580. In addition, the system shall consist of panel finishes, insulation, foil faced gypsum board vapor retarder, all accessories, components, and trim and all connections with roof panels. This includes roof penetration items such as Vents, curbs, exterior gutters and downspouts, ridge, wall, or other roof system flashings installed and any other components specified within this contract to provide a weathertight roof system; and items specified in other sections of the specifications that are part of the system.

#### 1.2.2 Manufacturer

The non-structural metal roofing system shall be the product of a manufacturer who has been in the practice of manufacturing metal roofs for a period of not less than 3 years and has been involved in at least five projects similar in size and complexity to this project.

#### 1.2.3 Installer

The installer shall be certified by the metal roof manufacturer to have experience in installing at least three projects that are of comparable size, scope and complexity as this project for the particular roof system furnished. The installer may be either employed by the manufacturer or be an independent installer.

### 1.3 DESIGN LOADS

Wind uplift pressures are shown on the structural drawings. Non-Structural Metal Roof System assemblies shall be approved to resist wind uplift pressures of Class 90 as defined in UL-580.

### 1.4 PERFORMANCE REQUIREMENTS

The metal roofing system supplied shall be suitable for the roof slope, the underlayment, and uplift pressures shown on the structural drawings.

The Contractor shall furnish a commercially available roofing system manufacturer's product, which satisfies all requirements contained herein and has been verified by load testing and independent design analyses to meet the specified design requirements.

### 1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

#### SD-04 Drawings

Metal Roofing; GA.

Drawings consisting of catalog cuts, erection drawings, shop coating and finishing specifications, and other data as necessary to clearly describe materials, sizes, layouts, construction details, fasteners, and erection.

Drawings consisting of UL tested assemblies showing the roofing system assembly is approved as Class 90 uplift resistance in accordance with UL-580.

#### SD-13 Certificates

Roof Panels; GA. Installation; FIO. Accessories; GA.

Certificates attesting that the panels and accessories conform to the specified requirements. Certificate for the roof assembly shall certify that the assembly complies with the material and fabrication requirements specified and is suitable for the installation at the indicated design slope. Certified laboratory test reports showing that the sheets to be furnished are produced under a continuing quality control program and that at least five (5) representative samples of similar material to that which will be provided on this project have been previously tested and have met the quality standards specified for factory color finish.

Insulation; GA.

Certificate attesting that the polyurethane or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

Installer; FIO.

Certification of installer.

Warranties; FIO.

At the completion of the project, signed copies of the 5-year Warranty for Non-Structural Metal Roofing System, a sample copy of which is attached to this section, and the 20-year Manufacturer's Material and Watertightness Warranties.

SD-14 Samples

Accessories; FIO.

One sample of each type of flashing, trim, fascia, closure, cap and similar items. Size shall be sufficient to show construction and configuration.

Roof Panels; GA.

One piece of each type and finish to be used, 9 inches long, full width.

Fasteners; GA.

Two samples of each type to be used with statement regarding intended use. If so requested, random samples of screws, bolts, nuts, and washers as delivered to the jobsite shall be taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

Gaskets and Insulating Compounds; FIO.

Two samples of each type to be used and descriptive data.

Sealant; FIO.

One sample, approximately 0.5 kg, 1 pound, and descriptive data.

#### 1.6 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials shall be covered with weather tight coverings and kept dry. Material shall not be covered with plastic where such covering will allow sweating and condensation. Plastic may be used as tenting with air circulation allowed. Storage conditions shall provide good air circulation and protection from surface staining.

#### 1.7 WARRANTIES

The Non-Structural Metal Roofing System shall be warranted as outlined below. Any emergency temporary repairs conducted by the owner shall not negate the warranties.

##### 1.7.1 Contractor's Weathertightness Warranty

The Non-Structural Metal Roofing System shall be warranted by the Contractor on a no penal sum basis for a period of five years against material and workmanship deficiencies; system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, elements and/or inadequate resistance to specified service design loads, water leaks, and wind uplift damage. The warranty shall include the entire roofing system but not limited to the standing seam metal roof panels, fasteners, connectors, roof securement components, and assemblies tested and approved in accordance with UL 580. In addition, the system shall consist of panel finishes, slip sheet, insulation, foil-faced gypsum board, all accessories, components, and trim and all connections with roof panels. This includes roof penetration items such as Vents, curbs, gutters and downspouts; eaves, ridge, rake, gable, wall, or other

roof system flashings installed and any other components specified within this contract to provide a weathertight roof system; and items specified in other sections of the specifications that are part of the roof system. All material and workmanship deficiencies, system deterioration caused by exposure to the elements and/or inadequate service design loads, water leaks and wind uplift damage shall be repaired as approved by the Contracting Officer. See the attached Contractor's required warranty for issue resolution of warrantable defects. This warranty shall warrant and cover the entire cost of repair or replacement, including all material, labor, and related markups. The Contractor shall supplement this warranty with written warranties from the installer and system manufacturer, which shall be submitted along with Contractor's warranty; however, the Contractor shall be ultimately responsible for this warranty. The Contractor's written warranty shall be as outlined in attached WARRANTY FOR NON-STRUCTURAL METAL ROOF SYSTEM, and shall start upon final acceptance of the facility. It is required that the contractor provide a separate bond in favor of the owner (Government) covering the contractor's warranty responsibilities that remain effective throughout the five year Contractor's warranty period for the entire system as outlined above.

#### 1.7.2 Manufacturer's Material and System Weathertightness Warranties

The Contractor shall furnish, in writing, the following manufacturer's material warranties which cover all Non-Structural Metal Roofing System components such as roof panels, flashing, accessories, and trim, fabricated from coil material:

- a. A manufacturer's 20 year material warranty warranting that the zinc-coated steel, aluminum-zinc alloy coated steel or aluminum-coated steel as specified herein will not rupture, fail structurally, or perforate under normal atmospheric conditions at the site. Liability under this warranty shall be limited exclusively to the cost of either repairing or replacing nonconforming, ruptured, perforated, or structurally failed coil material.
- b. A manufacturer's 20 year exterior material finish warranty warranting that the factory color finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of 8 when measured in accordance with ASTM D 4214; or fade or change colors in excess of 5 NBS units as measured in accordance with ASTM D 2244. Liability under this warranty is exclusively limited to refinishing or replacing the defective coated coil material.
- c. A roofing system manufacturer's 20 year system weathertightness warranty.

## PART 2 PRODUCTS

### 2.1 ROOF PANELS

Panels shall be steel and shall have a factory color finish. Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope for slope lengths that do not exceed 30 feet. Sheets longer than 30 feet may be furnished if approved by the Contracting Officer. Width of sheets shall provide nominal 16 inches of coverage in place. Design provisions shall be made for thermal expansion and contraction consistent with the type of system to be used. All sheets shall be either square-cut or miter-cut.

#### 2.1.1 Steel Panels

Zinc-coated steel conforming to ASTM A 653; aluminum-zinc alloy coated steel conforming to ASTM A 792, AZ 55 coating; or aluminum-coated steel conforming to ASTM A 463, Type 2, coating designation T2 65. Uncoated roof panels shall be 0.024 inch thick minimum. Panels shall be within 95 percent of the nominal thickness.

### 2.1.2 NOT USED

## 2.2 ACCESSORIES

Accessories shall be compatible with the roofing furnished. Flashing, trim, metal closure strips, caps, and similar metal accessories shall be not less than the minimum thicknesses specified for roof panels. Exposed metal accessories shall be finished to match the panels furnished. Molded closure strips shall be closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the panels and shall not absorb or retain water.

## 2.3 FASTENERS

Fasteners for roof panels shall be zinc-coated steel, or nylon capped steel, type and size as recommended by the manufacturer to meet the performance requirements. Fasteners for accessories shall be the manufacturer's standard.

## 2.4 FACTORY COLOR FINISH

Panels shall have a factory applied polyvinylidene fluoride finish on the exposed side. The exterior finish shall consist of a baked-on topcoat with an appropriate prime coat. Color shall match the color indicated on the drawings. The exterior coating shall be a nominal 1 mil thickness consisting of a topcoat of not less than 0.7 mil dry film thickness and the paint manufacturer's recommended primer of not less than 0.2 mil thickness. The exterior color finish shall meet the test requirements specified below.

### 2.4.1 Salt Spray Test

A sample of the sheets shall withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of not less than 8F, few no. 8 blisters, as determined by ASTM D 714; and a rating of 1/8 inch failure at scribe, as determined by ASTM D 1654.

### 2.4.2 Formability Test

When subjected to testing in accordance with ASTM D 522 Method B, 1/8 inch diameter mandrel, the coating film shall show no evidence of fracturing to the naked eye.

### 2.4.3 Accelerated Weathering, Chalking Resistance and Color Change

A sample of the sheets shall be tested in accordance with ASTM D 4587, test condition D for 500 total hours. The coating shall withstand the weathering test without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with tape in accordance with ASTM D 3359, Test Method B, shall be considered as an area indicating loss of adhesion. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. For sheets required to have a low gloss finish, the chalk rating shall be not less than No. 6 and the color difference shall be not greater than 7 units.

### 2.4.4 Humidity Test

When subjected to a humidity cabinet test in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage or corrosion.

#### 2.4.5 Impact Resistance

Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 0.500 inch diameter hemispherical head indenter, equal to 1.5 times the metal thickness in mils, expressed in inch-pounds, with no loss of adhesion.

#### 2.4.6 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968, Method A, the coating system shall withstand a minimum of 50 liters of sand before the appearance of the base metal. The term "appearance of base metal" refers to the metallic coating on steel or the aluminum base metal.

#### 2.4.7 Specular Gloss

Finished roof surfaces for shall have a specular gloss value of 30 or less at 60 degrees when measured in accordance with ASTM D 523.

#### 2.4.8 Pollution Resistance

Coating shall show no visual effects when covered spot tested in a 10 percent hydrochloric acid solution for 24 hours in accordance with ASTM D 1308.

### 2.5 NOT USED

### 2.6 INSULATION

Insulation thickness shall be as shown on the contract drawings. Insulation shall be a standard product with the insulation manufacturer, factory marked or identified with insulation manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages.

#### 2.6.1 Rigid Board Insulation for Use Above a Roof Deck

##### 2.6.1.1 Polyurethane or Polyisocyanurate

Polyisocyanurate insulation shall conform to ASTM C 1289, Type I, Class 2 (having a minimum recovered material content of 9 percent by weight of core material in the polyisocyanurate portion).

##### 2.6.1.2 NOT USED

#### 2.6.2 Blanket Insulation

Blanket insulation shall conform to ASTM C 991.

### 2.7 NOT USED

### 2.8 SEALANT

Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubberlike consistency.

### 2.9 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

#### 2.10 VAPOR RETARDER

#### 2.10.1 Vapor Retarders as Integral Facing

Insulation facing shall have a permeability of 1.15 ng per Pa-second-square meter 0.02 perm or less when tested in accordance with ASTM E 96. Facing shall be a natural finish. Facings and finishes shall be factory applied.

#### 2.10.2 Vapor Retarder/Foil Faced Gypsum Wall Board Separate from Insulation

Vapor retarder material shall be integral with the foil faced 5/8" gypsum wall board that is placed over the metal roof deck. The foil faced gypsum wall board shall have the joints taped. A fully compatible polyethylene tape which has equal or better water vapor control characteristics than the foil vapor retarder material shall be provided. A cloth industrial duct tape in a utility grade shall also be provided to use as needed to protect the vapor retarder from puncturing.

#### 2.10.3 NOT USED

### 2.11 PREFABRICATED CURBS AND EQUIPMENT SUPPORTS

Prefabricated curbs and equipment supports shall be of structural quality, hot-dipped galvanized or galvalume sheet steel, factory primed and prepared for painting with mitered and welded joints. Integral base plates and water diverter crickets shall be provided. Minimum height of curb shall be 8 inches above finish roof. Curbs shall be constructed to match roof slope and to provide a level top surface for mounting of equipment. Curb flange shall be constructed to match configuration of roof panels. Curb size shall be coordinated, prior to curb fabrication, with the mechanical equipment to be supported. Strength requirements for equipment supports shall be coordinated to include all anticipated loads.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Installation shall be in accordance with the manufacturer's erection instructions and drawings. Dissimilar materials which are not compatible when contacting each other shall be insulated by means of gaskets or insulating compounds. Exposed surfaces and edges shall be kept clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Stained, discolored, or damaged sheets shall be removed from the site.

#### 3.1.1 NOT USED

#### 3.1.2 NOT USED

#### 3.1.3 NOT USED

### 3.2 INSULATION INSTALLATION

Insulation shall be installed as indicated and in accordance with manufacturer's instructions. Insulation shall be continuous over entire roof surface. Where expansion joints, terminations, and other connections are made, the cavity shall be filled with batt insulation and vapor retarder providing equivalent R-Value and perm rating as remaining insulation.

3.2.1 Board Insulation

Rigid insulation shall be laid in close contact. If more than one layer of insulation is required, joints in the second layer shall be offset from joints in the first layer. Rigid insulation shall be attached to the metal roof deck with bearing plates and fasteners, as recommended by the insulation manufacturer, so that the insulation joints are held tight against each other. Layout and joint pattern of insulation and fasteners shall be indicated on the shop drawings.

3.2.2 NOT USED

3.3 NOT USED

3.4 NOT USED

3.4.1 NOT USED

3.4.2 NOT USED

3.5 NOT USED

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY  
FOR  
NON-STRUCTURAL METAL ROOF SYSTEM

FACILITY DESCRIPTION: \_\_\_\_\_  
BUILDING NUMBER: \_\_\_\_\_  
CORPS OF ENGINEERS CONTRACT NUMBER : \_\_\_\_\_

CONTRACTOR

CONTRACTOR: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
POINT OF CONTACT: \_\_\_\_\_  
TELEPHONE NUMBER: \_\_\_\_\_

OWNER

OWNER: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
POINT OF CONTACT: \_\_\_\_\_  
TELEPHONE NUMBER: \_\_\_\_\_

CONSTRUCTION AGENT

CONSTRUCTION AGENT: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
POINT OF CONTACT: \_\_\_\_\_  
TELEPHONE NUMBER: \_\_\_\_\_

THE NON-STRUCTURAL METAL ROOF SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY \_\_\_\_\_ FOR A PERIOD OF FIVE (5) YEARS AGAINST WORKMANSHIP AND MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE AND LEAKAGE. THE STANDING SEAM METAL ROOFING SYSTEM COVERED UNDER THIS WARRANTY SHALL INCLUDE BUT NOT BE LIMITED TO THE FOLLOWING: THE ENTIRE ROOFING SYSTEM MANUFACTURER SUPPLIED FRAMING AND STRUCTURAL MEMBERS, METAL ROOF PANELS, FASTENERS, CONNECTORS, ROOF SECUREMENT COMPONENTS, AND ASSEMBLIES TESTED AND APPROVED IN ACCORDANCE WITH ASTM E 1592. IN ADDITION, THE SYSTEM PANEL FINISHES, SLIP SHEET, INSULATION, VAPOR RETARDER, ALL ACCESSORIES, COMPONENTS, AND TRIM AND ALL CONNECTIONS ARE INCLUDED. THIS INCLUDES ROOF PENETRATION ITEMS SUCH AS



VENTS, CURBS, SKYLIGHTS; INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS; EAVES, RIDGE, HIP, VALLEY, RAKE, GABLE, WALL, OR OTHER ROOF SYSTEM FLASHINGS INSTALLED AND ANY OTHER COMPONENTS SPECIFIED WITHIN THIS CONTRACT TO PROVIDE A WEATHERTIGHT ROOF SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF THE SPECIFICATIONS THAT ARE PART OF THE ROOF SYSTEM.

ALL MATERIALS DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE AND LEAKAGE ASSOCIATED WITH THE NON-STRUCTURAL METAL ROOF SYSTEM COVERED UNDER THIS WARRANTY SHALL BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER. THIS WARRANTY SHALL COVER THE ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL ACCEPTANCE ON \_\_\_\_\_ AND WILL REMAIN IN EFFECT FOR STATED DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

\_\_\_\_\_  
(Company President)

\_\_\_\_\_  
(Date)

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY  
FOR  
NON-STRUCTURAL METAL ROOFING SYSTEM  
(continued)

THE CONTRACTOR SUPPLEMENT THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE INSTALLER AND/OR MANUFACTURER OF THE NON-STRUCTURAL METAL ROOFING SYSTEM, WHICH SHALL BE SUBMITTED ALONG WITH THE CONTRACTOR'S WARRANTY; HOWEVER, THE CONTRACTOR WILL BE ULTIMATELY RESPONSIBLE FOR THE WARRANTY AS OUTLINED IN THE SPECIFICATIONS AND AS INDICATED IN THIS WARRANTY EXAMPLE.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTNING, FIRE, EXPLOSIONS, HURRICANES, TORNADOES, EARTHQUAKES, AND HAIL).
2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER PERSONNEL, INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE CAUSED BY FALLING OBJECTS.
3. DAMAGE BY STRUCTURAL FAILURE, SETTLEMENT, MOVEMENT, DISTORTION, WARPAGE, OR DISPLACEMENT OF THE BUILDING STRUCTURE OR ALTERATIONS MADE TO THE BUILDING.
4. CORROSION CAUSED BY EXPOSURE TO MARINE (SALT WATER) ATMOSPHERE; CONSTANT SPRAY OF EITHER SALT OR FRESH WATER; CORROSIVE CHEMICALS, ASH OR FUMES GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS, FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE LIKE.
5. FAILURE OF ANY PART OF THE NON-STRUCTURAL METAL ROOFING SYSTEM DUE TO ACTIONS BY THE OWNER TO INHIBIT FREE DRAINAGE FROM THE ROOF AND ALLOW PONDING WATER. CONTRACTOR'S DESIGN SHALL INSURE FREE DRAINAGE FROM THE ROOF AND NOT ALLOW PONDING WATER.
6. THIS WARRANTY APPLIES TO THE NON-STRUCTURAL METAL ROOFING SYSTEM. IT DOES NOT INCLUDE ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.
7. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN CONSENT OF THE CONTRACTOR; AND THIS WARRANTY AND THE CONTRACT PROVISIONS WILL TAKE PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES.

REPORTS OF LEAKS AND ROOF SYSTEM DEFICIENCIES SHALL BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT OF NOTICE BY TELEPHONE OR IN WRITING, FROM EITHER THE OWNER, OR CONTRACTING OFFICER. EMERGENCY REPAIRS, TO PREVENT FURTHER ROOF LEAKS, SHALL BE INITIATED IMMEDIATELY; A WRITTEN PLAN SHALL BE SUBMITTED FOR APPROVAL TO REPAIR OR REPLACE THIS ROOFING SYSTEM WITHIN SEVEN CALENDAR DAYS. ACTUAL WORK FOR PERMANENT REPAIRS OR REPLACEMENT SHALL BE STARTED WITHIN 30 DAYS AFTER RECEIPT OF NOTICE, AND COMPLETED WITHIN A REASONABLE TIME FRAME. IF THE CONTRACTOR FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED IN THE CONTRACT AND AS CONTAINED HEREIN, THE CONTRACTING OFFICER MAY HAVE THE NON-STRUCTURAL METAL ROOFING SYSTEM REPAIRED OR REPLACED BY OTHERS AND CHARGE THE COST TO THE CONTRACTOR. IN THE EVENT THE CONTRACTOR DISPUTES THE EXISTENCE OF A WARRANTABLE DEFECT HE MAY CHALLENGE THE OWNER'S DEMAND FOR REPAIRS AND/OR REPLACEMENT DIRECTED BY THE OWNER OR CONTRACTING OFFICER EITHER BY REQUESTING A CONTRACTING OFFICER'S DECISION, UNDER THE CONTRACT DISPUTES ACT, OR BY REQUESTING THAT AN ARBITRATOR RESOLVE THE ISSUE. THE REQUEST FOR AN ARBITRATOR MUST BE MADE WITHIN 48 HOURS OF BEING NOTIFIED OF THE DISPUTED DEFECTS. UPON BEING INVOKED THE PARTIES SHALL, WITHIN 10 DAYS JOINTLY REQUEST A LIST OF FIVE (5) ARBITRATORS FROM THE FEDERAL MEDIATION AND CONCILIATION SERVICE. THE PARTIES SHALL CONFER WITHIN 10 DAYS AFTER RECEIPT OF THE LIST TO SEEK AGREEMENT ON AN ARBITRATOR. IF THE PARTIES CANNOT AGREE ON AN ARBITRATOR, THE CONTRACTING OFFICER AND THE PRESIDENT OF THE CONTRACTOR'S COMPANY WILL STRIKE ONE (1) NAME FROM THE LIST ALTERNATIVELY

UNTIL ONE NAME REMAINS. THE REMAINING PERSON SHALL BE THE DULY SELECTED ARBITRATOR. THE COSTS OF THE ARBITRATION, INCLUDING THE ARBITRATOR'S FEE AND EXPENSES, COURT REPORTER, COURTROOM OR SITE SELECTED ETC. SHALL BE BORNE EQUALLY BETWEEN THE PARTIES. EITHER PARTY DESIRING A COPY OF THE TRANSCRIPT SHALL PAY FOR THE TRANSCRIPT. A HEARING WILL BE HELD AS SOON AS THE PARTIES CAN MUTUALLY AGREE A WRITTEN ARBITRATOR'S DECISION WILL BE REQUESTED NO LATER THAN 30 DAYS FOLLOWING THE HEARING. THE DECISION OF THE ARBITRATOR WILL NOT BE BINDING; HOWEVER, IT WILL BE ADMISSIBLE IN ANY SUBSEQUENT APPEAL UNDER THE CONTRACT DISPUTES ACT.

A FRAMED COPY OF THIS WARRANTY SHALL BE POSTED IN THE MECHANICAL ROOM OR OTHER APPROVED LOCATION DURING THE ENTIRE WARRANTY PERIOD.

--END OF SECTION--

SECTION C-07413

METAL SIDING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA-02 (1994) Aluminum Design Manual: Specifications and Guidelines for Aluminum Structures

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI-01 (1986; Addenda 1989) Cold-Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 463 (1996a) Steel Sheet, Aluminum-Coated, by the Hot-Dip Process

ASTM A 653 (1996) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 792 (1995) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

ASTM B 117 (1994) Operating Salt Spray (Fog) Testing Apparatus

ASTM B 209 (1996) Aluminum and Aluminum-Alloy Sheet and Plate

ASTM C 518 (1991) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

ASTM D 522 (1993a) Mandrel Bend Test of Attached Organic Coatings

ASTM D 714 (1987; R 1994) Evaluating Degree of Blistering of Paints

ASTM D 968 (1993) Abrasion Resistance of Organic Coatings by Falling Abrasive

ASTM D 1654 (1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ASTM D 2244 (1993) Calculation of Color Differences from Instrumentally Measured Color Coordinates

ASTM D 2247 (1994) Testing Water Resistance of Coatings in 100% Relative Humidity

ASTM D 2794	(1993) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(1995) Measuring Adhesion by Tape Test
ASTM D 4214	(1989) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4397	(1991) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 4587	(1991) Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water- Exposure Apparatus
ASTM E 84	(1995a) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials

#### AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(1995) Minimum Design Loads for Buildings and Other Structures
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## 1.2 GENERAL REQUIREMENTS

### 1.2.1 Design

Criteria, loading combinations, and definitions shall be in accordance with ASCE 7. Maximum calculated fiber stress shall not exceed the allowable value in the AISI or AA manuals; a one third overstress for wind is allowed. Midspan deflection under maximum design loads shall be limited to  $L/180$ . Contract drawings show the design wind loads and the extent and general assembly details of the metal siding. Members and connections not shown on the drawings shall be designed by the Contractor. Siding panels and accessories shall be the products of the same manufacturer. Steel siding design shall be in accordance with AISI-01.

### 1.2.2 Architectural Considerations

Panels profile shall be as shown on the drawings.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

#### SD-04 Drawings

Siding; GA.

Drawings consisting of catalog cuts, design and erection drawings, shop coating and finishing specifications, and other data as necessary to clearly describe design, materials, sizes, layouts, construction details, fasteners, and erection. Drawings shall be accompanied by engineering design calculations for the siding panels.

#### SD-13 Certificates

Siding; GA.

Installation; FIO.

Accessories; FIO.

Certificates attesting that the panels and accessories conform to the requirements specified. Certified laboratory test reports showing that the sheets to be furnished are produced under a continuing quality control program and that a representative sample consisting of not less than 5 pieces has been tested and has met the quality standards specified for factory color finish. Mill certification for structural bolts, siding, and wall liner panels.

Insulation; FIO.

Certificate attesting that the insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

#### SD-14 Samples

Accessories; GA.

One sample of each type of flashing, trim, closure, cap and similar items. Size shall be sufficient to show construction and configuration.

Siding; GA.

One piece of each type and finish (exterior and interior) to be used 9 inches long, full width.

Fasteners; GA.

Two samples of each type to be used with statement regarding intended use. If so requested, random samples of bolts, nuts, and washers as delivered to the jobsite shall be taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

Insulation; FIO.

One piece of each type to be used, and descriptive data covering installation.

Gaskets and Insulating Compounds; FIO.

Two samples of each type to be used and descriptive data.

Sealant; FIO.

One sample and descriptive data.

#### 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials shall be covered with weathertight coverings and kept dry. Storage accommodations for metal siding shall provide good air circulation and protection from surface staining.

#### 1.5 WARRANTIES

The Contractor shall provide a weather tight warranty for the metal siding for a period of 20 years to include siding panel assembly, 10 years against the wear of color finish, and 10 years against the corrosion of fasteners caused by

ordinary wear and tear by the elements. The warranties shall start upon final acceptance of the work or the date the Government takes possession, whichever is earlier.

## PART 2 PRODUCTS

### 2.1 SIDING

Panels shall be steel and shall have a factory color finish. Length of sheets shall be sufficient to cover the entire height of any unbroken wall surface when length of run is 30 feet or less. When length of run exceeds 30 feet, each sheet in the run shall extend over two or more spans. Sheets longer than 30 feet may be furnished if approved by the Contracting Officer. Width of sheets with overlapping configurations shall provide not less than 24 inches of coverage in place, and those with interlocking ribs shall provide not less than 12 inches of coverage in place.

#### 2.1.1 Wall Panels

Wall panels shall have interlocking ribs for securing adjacent sheets. Wall panels shall be fastened to framework using concealed fasteners.

#### 2.1.2 Steel Panels

Zinc-coated steel conforming to ASTM A 653; aluminum-zinc alloy coated steel conforming to ASTM A 792, AZ 55 coating; or aluminum-coated steel conforming to ASTM A 463, Type 2, coating designation T2 65.

#### 2.1.3 NOT USED

#### 2.1.4 Factory Insulated Panels

Insulated wall panels shall be factory-fabricated units with insulating core between metal face sheets, securely fastened together and uniformly separated with rigid spacers; facing of steel of composition and gauge specified for siding; and constructed to eliminate condensation on interior of the panel. Panels shall have a factory color finish. Insulation shall be compatible with adjoining materials; nonrunning and nonsettling; capable of retaining its R-value for the life of the metal facing sheets; and unaffected by extremes of temperature and humidity. The assembly shall have a flame spread rating not higher than 25, and smoke developed rating not higher than 50 when tested in accordance with ASTM E 84. The insulation shall remain odorless, free from mold, and not become a source of food and shelter for insects. Panels shall be not less than 8 inches wide and shall be in one piece for unbroken wall heights.

### 2.2 FACTORY COLOR FINISH

Panels shall have a factory applied polyvinylidene fluoride finish on the exposed side. The exterior finish shall consist of a baked-on topcoat with an appropriate prime coat. Color shall match the color indicated on the drawings. The exterior coating shall be a nominal 1 mil thickness consisting of a topcoat of not less than 0.7 mil dry film thickness and the paint manufacturer's recommended primer of not less than 0.2 mil thickness. The interior color finish shall consist of the same coating and dry film thickness as the exterior. The exterior color finish shall meet the test requirements specified below.

#### 2.2.1 Salt Spray Test

A sample of the sheets shall withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall

receive a rating of not less than 8F, few no. 8 blisters, as determined by ASTM D 714; and a rating of 1/8 inch failure at scribe, as determined by ASTM D 1654.

#### 2.2.2 Formability Test

When subjected to testing in accordance with ASTM D 522 Method B, 1/8 inch diameter mandrel, the coating film shall show no evidence of fracturing to the naked eye.

#### 2.2.3 Accelerated Weathering, Chalking Resistance and Color Change

A sample of the sheets shall be tested in accordance with ASTM D 4587, test condition D for 500 total hours. The coating shall withstand the weathering test without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with tape in accordance with ASTM D 3359, Test Method B, shall be considered as an area indicating loss of adhesion. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244.

#### 2.2.4 Humidity Test

When subjected to a humidity cabinet test in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage or corrosion.

#### 2.2.5 Impact Resistance

Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 0.500 inch diameter hemispherical head indenter, equal to 1.5 times the metal thickness in mils, expressed in inch-pounds, with no loss of adhesion.

#### 2.2.6 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968, Method A, the coating system shall withstand a minimum of 50 liters of sand before the appearance of the base metal. The term "appearance of base metal" refers to the metallic coating on steel or the aluminum base metal.

### 2.3 ACCESSORIES

Flashing, trim, metal closure strips, caps, and similar metal accessories shall be the manufacturer's standard products. Exposed metal accessories shall be finished to match the panels furnished. Molded closure strips shall be bituminous-saturated fiber, closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chlorided premolded to match configuration of the panels and shall not absorb or retain water.

### 2.4 FASTENERS

Fasteners for steel panels shall be zinc-coated steel, corrosion resisting steel, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Fasteners for aluminum panels shall be aluminum or corrosion resisting steel. Fasteners for attaching wall panels to supports shall provide both tensile and shear strength of not less than 3340 N 750 pounds per fastener. Fasteners for accessories shall be the manufacturer's standard. Exposed wall fasteners shall be color finished or provided with plastic color caps to match the panels. Nonpenetrating fastener system for wall panels using concealed clips shall be manufacturer's standard for the system provided.



#### 2.4.1 Screws

Screws shall be as recommended by the manufacturer.

#### 2.4.2 End-Welded Studs

Automatic end-welded studs shall be shouldered type with a shank diameter of not less than 3/16 inch and cap or nut for holding panels against the shoulder.

#### 2.4.3 Explosive Actuated Fasteners

Fasteners for use with explosive actuated tools shall have a shank of not less than 0.145 inch with a shank length of not less than 1/2 inch for fastening panels to steel and not less than 1 inch for fastening panels to concrete.

#### 2.4.4 Blind Rivets

Blind rivets shall be stainless steel with 1/8 inch nominal diameter shank. Rivets shall be threaded stem type if used for other than the fastening of trim. Rivets with hollow stems shall have closed ends.

#### 2.4.5 Bolts

Bolts shall be not less than 1/4 inch diameter, shouldered or plain shank as required, with proper nuts.

### 2.5 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown on the contract drawings. R-values shall be determined at a mean temperature of 75 degrees F in accordance with ASTM C 518. Insulation shall be a standard product with the insulation manufacturer, factory-marked or identified with insulation manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Blanket insulation shall have a facing as specified in paragraph VAPOR RETARDER. Insulation, including facings, shall have a flame spread not in excess of 75 and a smoke developed rating not in excess of 150 when tested in accordance with ASTM E 84. The stated R-value of the insulation shall be certified by an independent Registered Professional Engineer if tests are conducted in the insulation manufacturer's laboratory.

#### 2.6 NOT USED

#### 2.7 NOT USED

#### 2.8 SEALANT

Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubberlike consistency.

### 2.9 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Installation shall be in accordance with the manufacturer's erection instructions and drawings. Dissimilar materials which are not compatible when contacting each

other shall be insulated from each other by means of gaskets or insulating compounds. Improper or mislocated drill holes shall be plugged with an oversize screw fastener and gasketed washer; however, panels with an excess of such holes or with such holes in critical locations shall not be used. Exposed surfaces and edges shall be kept clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Stained, discolored, or damaged sheets shall be removed from the site.

### 3.1.1 Siding and Accessories

Siding shall be applied with the longitudinal configurations in the vertical position. Accessories shall be fastened into framing members, except as otherwise approved. Closure strips shall be provided as indicated and where necessary to provide weathertight construction.

#### 3.1.1.1 NOT USED

#### 3.1.1.2 Concealed Fastener Wall Panels

Panels shall be fastened to framing members with concealed fastening clips or other concealed devices standard with the manufacturer. Spacing of fastening clips and fasteners shall be in accordance with the manufacturer's written instructions. Spacing of fasteners and anchor clips along the panel interlocking ribs shall not exceed 12 inches on center except when otherwise approved. Fasteners shall not puncture metal sheets except as approved for flashing, closures, and trim; exposed fasteners shall be installed in straight lines. Interlocking ribs shall be sealed with factory-applied sealant. Joints at accessories shall be sealed.

--End of Section--

SECTION C-07416

STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM

07/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA-02 (1994) Aluminum Design Manual: Specifications and Guidelines for Aluminum Structures

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC-04 (1989) Specification for Structural Steel Buildings - Allowable Stress Design, Plastic Design

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI-01 (1986; Addenda 1989) Cold-Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 463 (1996a) Steel Sheet, Aluminum-Coated, by the Hot-Dip Process

ASTM A 653 (1996) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 792 (1995) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

ASTM B 117 (1994) Operating Salt Spray (Fog) Testing Apparatus

ASTM B 209 (1996) Aluminum and Aluminum-Alloy Sheet and Plate

ASTM C 518 (1991) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

ASTM C 991 (1992) Flexible Glass Fiber Insulation for Pre-Engineered Metal Buildings

ASTM C 1289 (1995) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board

ASTM D 522 (1993a) Mandrel Bend Test of Attached Organic Coatings

ASTM D 523 (1989; R 1994) Specular Gloss

ASTM D 714 (1987; R 1994) Evaluating Degree of Blistering of Paints

ASTM D 968 (1993) Abrasion Resistance of Organic Coatings by Falling Abrasive

ASTM D 1308	(1987; R 1993) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2244	(1993) Calculation of Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(1994) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 2794	(1993) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(1995) Measuring Adhesion by Tape Test
ASTM D 4214	(1989) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4397	(1996) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 4587	(1991) Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light-and Water-Exposure Apparatus
ASTM E 84	(1996a) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM E 1592	(1995) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference

#### AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(1995) Minimum Design Loads for Buildings and Other Structures
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#### METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA-01	(1996) Low Rise Building Systems Manual
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#### STEEL JOIST INSTITUTE (SJI)

SJI-01	(1994) Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders
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## 1.2 GENERAL REQUIREMENTS

The Contractor shall furnish a manufacturer's standard product which satisfies all requirements contained herein and has been verified by load testing and independent design analyses to meet the specified design requirements.

### 1.2.1 Manufacturer

The SSSMR system for the 626th FSB and 86th CSH Deployment Storage Buildings shall be the product of a manufacturer who has been in the practice of manufacturing SSSMR systems for a period of not less than 3 years and has been involved in at least five projects similar in size and complexity to this project.

### 1.2.2 Installer

The installer shall be certified by the SSSMR system manufacturer to have experience in installing at least three projects that are of comparable size, scope and complexity as this project for the particular roof system furnished. The installer may be either employed by the manufacturer or be an independent installer.

## 1.3 DESIGN REQUIREMENTS

The design of the SSSMR system shall be provided by the Contractor as a complete system. Members and connections not indicated on the drawings shall be designed by the Contractor. Roof panels, components, transitions, accessories, and assemblies shall be supplied by the same manufacturer.

### 1.3.1 Design Criteria

Design criteria shall be in accordance with MBMA-01 unless otherwise specified.

#### 1.3.2 Dead Loads

The dead load shall be the weight of the SSSMR system. Collateral loads such as sprinklers, mechanical and electrical systems, and ceilings shall not be attached to the panels.

#### 1.3.3 Live Loads

##### 1.3.3.1 Concentrated Loads

The panels and anchor clips shall be capable of supporting a 1335 N 300 pound concentrated load. The concentrated load shall be applied at the panel midspan and will be resisted by a single standing seam metal roof panel assumed to be acting as a beam. The undeformed shape of the panel shall be used to determine the section properties.

##### 1.3.3.2 Uniform Loads

The panels and concealed anchor clips shall be capable of supporting a minimum uniform live load of 20 psf.

#### 1.3.4 Roof Snow Loads

The design roof snow loads shall be as shown on the contract drawings.

#### 1.3.5 Wind Loads

The design wind uplift pressure for the roof system shall be as shown on the structural drawings. The design uplift force for each connection assembly shall be that pressure given for the area under consideration, multiplied by the tributary load area of the connection assembly. The safety factor listed below shall be applied to the design force and compared against the ultimate capacity. Prying shall be considered when figuring fastener design loads.

- a. Single fastener in each connection.....3.0
- b. Two or more fasteners in each connection...2.25

#### 1.3.6 Thermal Loads

Roof panels shall be free to move in response to the expansion and contraction forces resulting from a total temperature range of 220 degrees F during the life of the structure.

#### 1.3.7 Framing Members Supporting the SSSMR System

Any additions/revisions to framing members supporting the SSSMR system to accommodate the manufacturer/fabricator's design shall be the Contractor's responsibility and shall be submitted for review and approval. New or revised framing members and their connections shall be designed in accordance with AISC-04. Maximum deflection under applied live load, snow, or wind load shall not exceed 1/180 of the span length.

#### 1.3.8 Roof Panels Design

Steel panels shall be designed in accordance with AISI-01. The structural section properties used in the design of the panels shall be determined using the unloaded shape of the roof panels. The calculated panel deflection from concentrated loads shall not exceed 1/180 of the span length. The calculated panel deflection under applied live load, snow, or wind load shall not exceed 1/180 times the span length. Deflections shall be based on panels being continuous across three or more supports. Deflection shall be calculated and measured along the major ribs of the panels.

#### 1.3.9 Accessories and Their Fasteners

Accessories and their fasteners shall be capable of resisting the specified design wind uplift forces and shall allow for thermal movement of the roof panel system. Exposed fasteners shall not restrict free movement of the roof panel system resulting from thermal forces. There shall be a minimum of two fasteners per clip. Single fasteners with a minimum diameter of 3/8 inch will be allowed when the supporting structural members are prepunched or predrilled.

### 1.4 PERFORMANCE REQUIREMENTS

The SSSMR shall be tested for wind uplift resistance in accordance with ASTM E 1592; SSSMR systems previously tested and approved by the Corps of Engineers' STANDARD TEST METHOD FOR STRUCTURAL PERFORMANCE OF SSMRS BY UNIFORM STATIC AIR PRESSURE DIFFERENCE may be acceptable. Two tests shall be performed. Test 1 shall simulate the edge condition with one end having crosswise restraint and other end free of crosswise restraint. The maximum span length for the edge condition shall be 30 inches. Test 2 shall simulate the interior condition with both ends free of crosswise restraint. The maximum span length for the interior condition shall be 5.0 feet. External reinforcement, such as clamps on the ribs, shall not be installed to improve uplift resistance. Bolts through seams shall not be installed.

### 1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-01 Data

Design Analysis; GA.

Design analysis signed by a Registered Professional Engineer employed by the SSSMR manufacturer. The design analysis shall include a list of the design loads, and complete calculations for the support system, roofing system and its components; valley designs, gutter/downspout calculations, screw pullout test results, and shall indicate how expected thermal movements are accommodated.

SD-04 Drawings

Structural Standing Seam Metal Roof System; GA.

Metal roofing drawings and specifications and erection drawings; shop coating and finishing specifications; and other data as necessary to clearly describe design, materials, sizes, layouts, standing seam configuration, construction details, provisions for thermal movement, line of panel fixity, fastener sizes and spacings, sealants and erection procedures. Drawings shall reflect the intent of the architectural detailing using the manufacturer's proprietary products and fabricated items as required. The SSSMR system shop drawings shall be provided by the metal roofing manufacturer.

#### SD-08 Statements

Qualifications; GA.

Qualifications of the manufacturer and installer.

#### SD-09 Reports

Test Report for Uplift Resistance of the SSSMR; GA.

The report shall include the following information:

- a. Details of the SSSMR system showing the roof panel cross-section with dimensions and thickness.
- b. Details of the anchor clip, dimensions, and thickness.
- c. Type of fasteners, size, and the number required for each connection.
- d. Purlins/subpurlins size and spacing used in the test.
- e. Description of the seaming operation including equipment used.
- f. Maximum allowable uplift pressures. These pressures are determined from the ultimate load divided by a factor of safety equal to 1.65.
- g. Any additional information required to identify the SSSMR system tested.
- h. Signature and seal of an independent registered engineer who witnessed the test.

#### SD-13 Certificates

Structural Standing Seam Metal Roof System; GA.

- a. Certification that the actual thickness of uncoated sheets used in SSSMRS components including roofing panels, subpurlins, and concealed anchor clips complies with specified requirements.
- b. Certification that materials used in the installation are mill certified.
- c. Previous certification of SSSMR system tested under the Corps of Engineers' Standard Test Method in lieu of ASTM E 1592 testing.
- d. Certification that the sheets to be furnished are produced under a continuing quality control program and that a representative sample consisting of not less than three pieces has been tested and has met the quality standards specified for factory color finish.
- e. Certification of installer.
- f. Warranty certificate. At the completion of the project the Contractor shall furnish signed copies of the 5-year Warranty for Structural Standing Seam

Metal Roof (SSSMR) System, a sample copy of which is attached to this section, and the 20-year Manufacturer's Material Warranties.

Insulation; GA.

Certificate attesting that the polyurethane or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

SD-14 Samples

Accessories; FIO.

One sample of each type of flashing, trim, closure, thermal spacer block, cap and similar items. Size shall be sufficient to show construction and configuration.

Roof Panels; GA

One piece of each type to be used, 9 inches long, full width.

Factory Color Finish; GA.

Three 3 by 5 inches samples of each type and color.

Fasteners; GA.

Two samples of each type to be used, with statement regarding intended use. If so requested, random samples of bolts, nuts, and washers as delivered to the job site shall be taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

Gaskets and Insulating Compounds; FIO.

Two samples of each type to be used and descriptive data.

Sealant; FIO.

One sample and descriptive data.

Concealed Anchor Clips; GA.

Two samples of each type used.

EPDM Rubber Boots; FIO.

One piece of each type.

#### 1.6 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials shall be covered with weathertight coverings and kept dry. Storage conditions shall provide good air circulation and protection from surface staining.

#### 1.7 WARRANTIES

The SSSMR system shall be warranted as outlined below. Any emergency temporary repairs conducted by the owner shall not negate the warranties.



#### 1.7.1 Contractor's Weathertightness Warranty

The SSSMR system shall be warranted by the Contractor on a no penal sum basis for a period of five years against material and workmanship deficiencies; system deterioration caused by ordinary exposure to the elements and service design loads, water leaks, and wind uplift damage. The SSSMR system covered under this warranty shall include the entire roofing system including, but not limited to, the following: panel seams and joint, all accessories, components and trim; penetrations such as vents, curbs, and skylights; interior or exterior gutters and downspouts; eaves, ridge, hip, valley, rake, gable, wall, or other roof system flashings installed to provide a weathertight roof system; and items specified in other sections of these specifications that become part of the structural standing seam metal roof system. All material and workmanship deficiencies, system deterioration caused by ordinary exposure to the elements and service design loads, water leaks and wind uplift damage shall be repaired as approved by the Contracting Officer. This warranty shall warrant and cover the entire cost of repair or replacement, including all material, labor, and related markups. The Contractor may supplement this warranty with written warranties from the installer and/or manufacturer, which shall be submitted along with Contractor's warranty; however, the Contractor shall be ultimately responsible for this warranty. The Contractor's written warranty shall be as outlined in attached example WARRANTY FOR STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM, and shall start upon final acceptance of the facility or the date the Government takes possession, whichever is earlier. It shall be understood that the Contractor's Performance Bond will remain effective throughout the five year Contractor's warranty period for the entire SSSMR system as outlined above.

#### 1.7.2 Manufacturer's Material Warranties.

The Contractor shall furnish, in writing, the following manufacturer's material warranties which cover all SSSMR system components such as roof panels, anchor clips and fasteners, flashing, accessories, and trim, fabricated from coil material:

- a. A manufacturer's 20 year material warranty warranting that the zinc-coated steel, aluminum-zinc alloy coated steel or aluminum-coated steel as specified herein will not rupture, structurally fail, fracture, deteriorate, or become perforated under normal design atmospheric conditions and service design loads. Liability under this warranty shall be limited exclusively to the cost of either repairing or replacing nonconforming, ruptured, perforated, or structurally failed coil material.
- b. A manufacturer's 20 year exterior material finish warranty on the factory colored finish warranting that the finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of eight, as determined by ASTM D 4214 test procedures; or change color in excess of five CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. Liability under this warranty is exclusively limited to refinishing with an air-drying version of the specified finish or replacing the defective coated material.

## PART 2 PRODUCTS

### 2.1 ROOF PANELS

Panels shall be steel and shall have a factory color finish. Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope for slope lengths that do not exceed 30 feet. When length of run exceeds 30 feet and panel laps are provided, each sheet in the run shall extend over three or more supports. Sheets longer than 100 feet may be furnished if approved by the Contracting Officer. Width of sheets shall provide not more than 24 inches of coverage in place. SSSMR system with roofing panels greater than 12 inches in width shall have standing seams rolled during installation by an electrically driven seaming machine. Height of standing seams shall be not less than 2 inches.

#### 2.1.1 Steel Panels

Steel panels shall be zinc-coated steel conforming to ASTM A 653; aluminum-zinc alloy coated steel conforming to ASTM A 792, AZ 55 coating; or aluminum-coated steel conforming to ASTM A 463, Type 2, coating designation T2 65. Uncoated panels shall be 0.0239 inch thick minimum. Panels shall be within 95 percent of tested thickness. Panels that have become wet during shipment and have started to oxidize shall be rejected.

#### 2.1.2 NOT USED

### 2.2 CONCEALED ANCHOR CLIPS

Concealed anchor clips shall be the same as the tested roofing system. Clip bases shall have factory punched or drilled holes for attachment. Clips shall be made from multiple pieces with the allowance for the total thermal movement required to take place within the clip. Single piece clips may be acceptable when the manufacturer can substantiate that the system can accommodate the thermal cyclic movement under sustained live or snow loads.

### 2.3 ACCESSORIES

Flashing, trim, metal closure strips, caps and similar metal accessories shall be the manufacturer's standard products. Exposed metal accessories shall be finished to match the panels furnished. Molded closure strips shall be closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the panels and shall not absorb or retain water. Die cast metal closures shall be installed with double bead tape sealant and fasteners that stitch the panel to a 2 mm 16 gage preformed backer plate to ensure a positive compression of the tape sealant. The use of a continuous angle butted to the panel ends to form a closure will not be allowed.

### 2.4 FASTENERS

Fasteners for steel roof panels shall be zinc-coated steel, corrosion resisting steel, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Fasteners for structural connections shall provide both tensile and shear ultimate strengths of not less than 3340 N 750 pounds per fastener. Fasteners for accessories shall be the manufacturer's standard.

#### 2.4.1 Screws

Screws for attaching anchor devices shall be not less than No. 14. Actual screw pull out test results shall be performed for the actual material gage and yield strength of the structural purlins or subpurlins to which the clip is to be

anchored/attached. Other screws shall be as recommended by the manufacturer to meet the strength design requirements of the panels.

#### 2.4.2 Bolts

Bolts shall be not less than 1/4 inch diameter, shouldered or plain shank as required, with locking washers and nuts.

#### 2.4.3 Structural Blind Fasteners

Blind screw-type expandable fasteners shall be not less than 1/4 inch diameter. Blind (pop) rivets shall be not less than 9/32 inch minimum diameter.

### 2.5 SUBPURLINS

Cold formed supporting structural members/subpurlins shall have a minimum thickness of 0.059 inches and a minimum tensile yield strength of 50000 psi. Hot rolled structural members shall have a minimum thickness of 0.25 inches and a minimum tensile yield strength of 36000 psi. Subpurlins shall be galvanized or given one coat of shop paint.

### 2.6 FACTORY COLOR FINISH

Panels shall have a factory applied polyvinylidene fluoride finish on the exposed side. The exterior finish shall consist of a baked-on topcoat with an appropriate prime coat. Color shall match the color indicated on the drawings. The exterior coating shall be a nominal 1 mil thickness consisting of a topcoat of not less than 0.7 mil dry film thickness and the paint manufacturer's recommended primer of not less than 0.2 mil thickness. The interior color finish shall consist of the same coating and dry film thickness as the exterior. The exterior color finish shall meet the test requirements specified below.

#### 2.6.1 Salt Spray Test

A sample of the sheets shall withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of not less than 8F, few No. 8 blisters, as determined by ASTM D 714; and a rating of 1/8 inch failure at scribe, as determined by ASTM D 1654.

#### 2.6.2 Formability Test

When subjected to testing in accordance with ASTM D 522 Method B, 3 mm 1/8 inch diameter mandrel, the coating film shall show no evidence of cracking to the naked eye.

#### 2.6.3 Accelerated Weathering, Chalking Resistance and Color Change

A sample of the sheets shall be tested in accordance with ASTM D 4587, test condition D for 500 total hours. The coating shall withstand the weathering test without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with tape in accordance with ASTM D 3359, Test Method B, shall be considered as an area indicating loss of adhesion. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. For sheets required to have a low gloss finish, the chalk rating shall be not less than No. 6 and the color difference shall be not greater than 7 units.

#### 2.6.4 Humidity Test

When subjected to a humidity cabinet test in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage or corrosion.

#### 2.6.5 Impact Resistance

Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 0.500 inch diameter hemispherical head indenter, equal to 1.5 times the metal thickness in mils, expressed in inch-pounds, with no loss of adhesion.

#### 2.6.6 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968, Method A, the coating system shall withstand a minimum of ~~†50†~~ ~~†80†~~ liters of sand before the appearance of the base metal. The term "appearance of base metal" refers to the metallic coating on steel or the aluminum base metal.

#### 2.6.7 Specular Gloss

Finished roof surfaces shall have a specular gloss value of 30 or less at 60 degrees when measured in accordance with ASTM D 523.

#### 2.6.8 Pollution Resistance

Coating shall show no visual effects when covered spot tested in a 10 percent hydrochloric acid solution for 24 hours in accordance with ASTM D 1308.

#### 2.7 NOT USED

#### 2.8 NOT USED

#### 2.9 SEALANT

Sealants shall be elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubberlike consistency. Sealant placed in the roof panel standing seam ribs shall be provided in accordance with the manufacturer's recommendations.

#### 2.10 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

#### 2.11 NOT USED

#### 2.12 NOT USED

#### 2.13 NOT USED

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Installation shall be in accordance with the manufacturer's erection instructions and drawings. Dissimilar materials which are not compatible when contacting each other shall be insulated by means of gaskets or insulating compounds. Molded closure strips shall be installed wherever roofing sheets terminate in open-end configurations, exclusive of flashings. The closure strip installation shall be weather-tight and sealed. Screws shall be installed with a clutching screw gun, to assure screws are not stripped. Field test shall be conducted on each gun

prior to starting installation and periodically thereafter to assure it is adjusted properly to install particular type and size of screw as recommended by manufacturer's literature. Improper or mislocated drill holes shall be plugged with an oversize screw fastener and gasketed washer; however, sheets with an excess of such holes or with such holes in critical locations shall not be used. Exposed surfaces and edges shall be kept clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Stained, discolored, or damaged sheets shall be removed from the site.

3.1.1 NOT USED

3.1.2 NOT USED

3.1.3 Roof Panel Installation

Roof panels shall be installed with the standing seams in the direction of the roof slope. The side seam connections for installed panels shall be completed at the end of each day's work. Method of applying joint sealant shall conform to the manufacturer's recommendation to achieve a complete weather-tight installation. End laps of panels shall be provided in accordance with the manufacturer's instructions. Closures, flashings, EPDM rubber boots, roof curbs, and related accessories shall be installed according to the manufacturer's drawings. Fasteners shall not puncture roofing sheets except as provided for in the manufacturer's instructions for erection and installation. Expansion joints for the standing seam roof system shall be installed at locations indicated on the contract drawings and other locations indicated on the manufacturer's drawings.

3.1.4 Concealed Anchor Clips

Concealed anchor clips shall be fastened directly to the structural framing members. The maximum distance, parallel to the seams, between clips shall be 30 inches on center at the corner, edge, and ridge zones, and 5 feet maximum on centers for the remainder of the roof.

3.2 NOT USED

3.3 NOT USED

3.4 NOT USED

3.5 NOT USED

3.6 CLEANING AND TOUCH-UP

Exposed SSSMR systems shall be cleaned at completion of installation. Debris that could cause discoloration and harm to the panels, flashings, closures and other accessories shall be removed. Grease and oil films, excess sealants, and handling marks shall be removed and the work shall be scrubbed clean. Exposed metal surfaces shall be free of dents, creases, waves, scratch marks, and solder or weld marks. Immediately upon detection, abraded or corroded spots on shop-painted surfaces shall be wire brushed and touched up with the same material used for the shop coat. Factory color finished surfaces shall be touched up with the manufacturer's recommended touch up paint.

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY  
FOR  
STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM

PROJECT DESCRIPTION AND LOCATION (Include Bldg. No.): \_\_\_\_\_  
CORPS OF ENGINEERS CONTRACT NUMBER: \_\_\_\_\_  
SPECIFICATION SECTION NUMBER & DESCRIPTION:  
07416 STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM

CONTRACTOR: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
POINT OF CONTACT: \_\_\_\_\_  
TELEPHONE NUMBER: \_\_\_\_\_

OWNER: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
POINT OF CONTACT: \_\_\_\_\_  
TELEPHONE NUMBER: \_\_\_\_\_

CONSTRUCTION AGENT: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
POINT OF CONTACT: \_\_\_\_\_  
TELEPHONE NUMBER: \_\_\_\_\_

THE SSSMR SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY \_\_\_\_\_  
\_\_\_\_\_ FOR A PERIOD OF FIVE (5) YEARS AGAINST WORKMANSHIP AND MATERIAL  
DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE AND LEAKAGE. THE SSSMR SYSTEM  
COVERED UNDER THIS WARRANTY SHALL INCLUDE THE ENTIRE ROOFING SYSTEM, INCLUDING  
THE STANDING SEAM METAL ROOF PANELS, PANEL FINISHES, ROOFING SECUREMENT  
COMPONENTS, ALL ACCESSORIES, COMPONENTS, AND TRIM; INCLUDING PENETRATIONS SUCH  
VENTS, CURBS, SKYLIGHTS; INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS; EAVES,  
RIDGE, HIP, VALLEY, RAKE, GABLE, WALL, OR OTHER ROOF SYSTEM FLASHINGS INSTALLED  
TO PROVIDE A WEATHERTIGHT ROOF SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF  
THE SPECIFICATIONS THAT ARE PART OF THE SSSMR SYSTEM. ALL LEAKS SHALL BE  
REPAIRED AS APPROVED BY THE CONTRACTING OFFICER. THIS WARRANTY SHALL COVER THE  
ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED  
MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL  
ACCEPTANCE ON \_\_\_\_\_ AND WILL REMAIN IN EFFECT FOR STATED  
DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

\_\_\_\_\_  
(Company President) (Date)

(SEE REVERSE SIDE FOR SUPPLEMENTAL PROVISIONS AND EXCLUSIONS)

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY  
FOR  
STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM  
(continued)

THE CONTRACTOR MAY SUPPLEMENT THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE INSTALLER AND/OR MANUFACTURER OF THE SSSMR SYSTEM, WHICH SHALL BE SUBMITTED ALONG WITH THE CONTRACTOR'S WARRANTY. HOWEVER, THE CONTRACTOR WILL BE ULTIMATELY RESPONSIBLE FOR THE WARRANTY AS OUTLINED IN THE SPECIFICATIONS AND AS INDICATED IN THIS WARRANTY EXAMPLE.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTING, FIRE, EXPLOSIONS, SUSTAINED WIND FORCES IN EXCESS OF THE DESIGN CRITERIA, EARTHQUAKES, AND HAIL).
2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER PERSONNEL, INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE CAUSED BY FALLING OBJECTS.
3. DAMAGE BY STRUCTURAL FAILURE, SETTLEMENT, MOVEMENT, DISTORTION, WARPAGE, OR DISPLACEMENT OF THE BUILDING STRUCTURE OR ALTERATIONS MADE TO THE BUILDING.
4. CORROSION CAUSED BY EXPOSURE TO CORROSIVE CHEMICALS, ASH OR FUMES GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS, FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE LIKE.
5. FAILURE OF ANY PART OF THE SSSMR SYSTEM DUE TO ACTIONS BY THE OWNER TO INHIBIT FREE DRAINAGE FROM THE ROOF AND ALLOW PONDING WATER. CONTRACTOR'S DESIGN SHALL INSURE FREE DRAINAGE FROM THE ROOF AND NOT ALLOW PONDING WATER.
6. THIS WARRANTY APPLIES TO THE STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM. IT DOES NOT INCLUDE ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.
7. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN CONSENT OF THE CONTRACTOR AND THIS WARRANTY AND THE CONTRACT PROVISIONS WILL TAKE PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES, UNLESS OTHERWISE APPROVED IN WRITING BY THE CONTRACTING OFFICER.

LEAKS SHALL BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT OF NOTICE BY TELEPHONE OR IN WRITING FROM EITHER THE OWNER, OR CONTRACTING OFFICER. EMERGENCY REPAIRS, TO PREVENT FURTHER ROOF LEAKS, SHALL BE INITIATED IMMEDIATELY; A WRITTEN PLAN SHALL BE SUBMITTED FOR APPROVAL TO REPAIR OR REPLACE THIS SSSMR SYSTEM WITHIN SEVEN CALENDAR DAYS. ACTUAL WORK FOR PERMANENT REPAIRS OR REPLACEMENT SHALL BE STARTED WITHIN 30 DAYS AFTER RECEIPT OF NOTICE, AND COMPLETED WITHIN A REASONABLE TIME FRAME. IF THE CONTRACTOR FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED IN THE CONTRACT AND AS CONTAINED HEREIN, THE CONTRACTING OFFICER MAY HAVE THE SSSMR SYSTEM REPAIRED OR REPAIRED BY OTHERS AND CHARGE THE COST TO THE CONTRACTOR.

A FRAMED COPY OF THIS WARRANTY SHALL BE POSTED IN THE MECHANICAL ROOM OR OTHER APPROVED LOCATION DURING THE ENTIRE WARRANTY PERIOD.

--END OF SECTION--

## SECTION C-07600

### SHEET METALWORK, GENERAL

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM B 32	(1996) Solder Metal
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM D 226	(1997) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 543	(1995) Evaluating the Resistance of Plastics to Chemical Reagents
ASTM D 822	(1996) Conducting Tests on Paint and Related Coatings and Materials Using Filtered Open-Flame Carbon-Arc Exposure Apparatus
ASTM D 828	(1993) Tensile Breaking Strength of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus
ASTM D 2822	(1991; R1997) Asphalt Roof Cement
ASTM D 4586	(1993) Asphalt Roof Cement, Asbestos Free
ASTM E 96	(1995) Water Vapor Transmission of Materials

##### SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)

SMACNA-02	(1993; Errata) Architectural Sheet Metal Manual
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##### 1.2 GENERAL REQUIREMENTS

Sheet metalwork shall be accomplished to form weathertight construction without waves, warps, buckles, fastening stresses or distortion, and shall allow for expansion and contraction.

###### 1.2.1 Coordination

Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades shall be performed by sheet metal mechanics. Installation of sheet metal items used in conjunction with



roofing shall be coordinated with roofing work to permit continuous roofing operations. Sheet metalwork pertaining to heating, ventilating, and air conditioning is specified in Section 15895, AIR SUPPLY, DISTRIBUTION, VENTILATION AND EXHAUST SYSTEM.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

#### SD-04 Drawings

Materials; FIO.

Drawings of sheet metal items showing weights, gauges or thicknesses; types of materials; expansion-joint spacing; fabrication details; and installation procedures.

### 1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be adequately packaged and protected during shipment and shall be inspected for damage, dampness, and wet-storage stains upon delivery to the jobsite. Materials shall be clearly labeled as to type and manufacturer. Sheet metal items shall be carefully handled to avoid damage. Materials shall be stored in dry, ventilated areas until immediately before installation.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Lead, lead-coated metal, copper, and galvanized steel shall not be used. Any metal listed by SMACNA-02 for a particular item may be used, unless otherwise specified or indicated. Materials shall conform to the requirements specified below and to the thicknesses and configurations established in SMACNA-02. Different items need not be of the same metal.

#### 2.1.1 Accessories

Accessories and other items essential to complete the sheet metal installation, though not specifically indicated or specified, shall be provided.

#### 2.1.2 Aluminum Extrusions

ASTM B 221, Alloy 6063, Temper T5.

#### 2.1.3 Bituminous Cement

Type I asphalt cement conforming to ASTM D 2822 or ASTM D 4586.

#### 2.1.4 Sealant

Unless otherwise specified, sealant shall be an elastomeric weather resistant sealant as specified in Section C-07920 JOINT SEALING.

#### 2.1.5 Fasteners

Fasteners shall be compatible with the fastened material and shall be the type best suited for the application.

#### 2.1.6 Felt

ASTM D 226, Type I.

2.1.7 NOT USED

2.1.8 Aluminum Alloy Sheet and Plate

ASTM B 209, form, alloy, and temper appropriate for use.

2.1.9 NOT USED

2.1.10 Stainless Steel

ASTM A 167, Type 302 or 304; fully annealed, dead soft temper.

2.1.11 Solder

ASTM B 32, 95-5 tin-antimony.

2.1.12 Through-Wall Flashing

a. NOT USED

b. Stainless steel, Type 304, not less than 0.003 inch thick, completely encased by and permanently bonded on both sides to 50 pound high strength bituminized crepe kraft paper, using hot asphalt, heat, and pressure.

2.1.13 NOT USED

### PART 3 EXECUTION

#### 3.1 GENERAL

Items such as gutters, downspouts and louvers shall be fabricated in conformance with SMACNA-02 and as indicated. Unless otherwise specified or indicated, exposed edges shall be folded back to form a 1/2 inch hem on the concealed side, and bottom edges of exposed vertical surfaces shall be angled to form drips.

#### 3.2 EXPANSION JOINTS

Expansion joints shall be provided as specified in SMACNA-02. Expansion joints in continuous sheet metal shall be provided at 40 foot intervals for stainless steel and at 32 foot intervals for aluminum, except extruded aluminum fasciae which shall have expansion joints at not more than 12 foot spacing. Joints shall be evenly spaced. An additional joint shall be provided where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing.

#### 3.3 PROTECTION OF ALUMINUM

Aluminum shall not be used where it will be in contact with copper or where it will contact water which flows over copper surfaces. Aluminum that will be in contact with wet or pressure-treated wood, mortar, concrete, masonry, or ferrous metals shall be protected against galvanic or corrosive action by one of the following methods:

##### 3.3.1 Paint

Aluminum surfaces shall be solvent cleaned and given one coat of zinc-molybdate primer and one coat of aluminum paint as specified in Section C-09900 PAINTING, GENERAL.

### 3.3.2 Nonabsorptive Tape or Gasket

Nonabsorptive tape or gasket shall be placed between the adjoining surfaces and cemented to the aluminum surface using a cement compatible with aluminum.

## 3.4 CONNECTIONS AND JOINTING

### 3.4.1 Soldering

Soldering shall apply to stainless steel items. Edges of sheet metal shall be pretinned before soldering is begun. Soldering shall be done slowly with well heated soldering irons so as to thoroughly heat the seams and completely sweat the solder through the full width of the seam. Edges of stainless steel to be pretinned shall be treated with soldering acid flux. Soldering shall follow immediately after application of the flux. Upon completion of soldering, the acid flux residue shall be thoroughly cleaned from the sheet metal with a water solution of washing soda and rinsed with clean water.

### 3.4.2 Riveting

Joints in aluminum sheets 0.040 inch or less in thickness shall be mechanically made.

### 3.4.3 Seaming

Flat-lock and soldered-lap seams shall finish not less than 1 inch wide. Unsoldered plain-lap seams shall lap not less than 3 inches unless otherwise specified. Flat seams shall be made in the direction of the flow.

## 3.5 CLEATS

A continuous cleat shall be provided where indicated or specified to secure loose edges of the sheet metalwork. Butt joints of cleats shall be spaced approximately 1/8 inch apart. The cleat shall be fastened to supporting wood construction with nails evenly spaced not over 12 inches on centers. Where the fastening is to be made to concrete or masonry, screws shall be used and shall be driven in expansion shields set in concrete or masonry.

## 3.6 GUTTERS AND DOWNSPOUTS

Gutters and downspouts shall be designed according to the requirements of SMACNA-02 for storms which should be exceeded only once in 5 years and with adequate provisions for thermal expansion and contraction. Supports for gutters and downspouts shall be designed for the anticipated loads. Color to be as shown on Color Schedule on drawings.

## 3.7 FLASHINGS

Flashings shall be installed at locations indicated and as specified below. Sealing shall be according to the flashing manufacturer's recommendations. Flashings shall be installed at intersections of roof with vertical surfaces and at projections through roof, except that flashing for heating and plumbing, including piping, roof, and floor drains, and for electrical conduit projections through roof or walls are specified in other sections. Perforations in flashings made by masonry anchors shall be covered up by an application of bituminous plastic cement at the perforation. Flashing shall be installed on top of joint reinforcement. Flashing shall be formed to direct water to the outside of the system.

### 3.7.1 NOT USED

### 3.7.2 NOT USED

3.7.3 NOT USED

#### 3.7.4 Through-Wall Flashing

Through-wall flashing includes sill, lintel, and spandrel flashing. The flashing shall be laid with a layer of mortar above and below the flashing so that the total thickness of the two layers of the mortar and flashing are the same thickness as the regular mortar joints. Flashing shall not extend further into the masonry backup wall than the first mortar joint. Joints in flashing shall be lapped and sealed. Flashing shall be one piece for lintels and sills.

##### 3.7.4.1 Lintel Flashing

Lintel flashing shall extend the full length of lintel. Flashing shall extend through the wall one masonry course above the lintels and shall be bent down over the vertical leg of the outer steel lintel angle not less than 2 inches, or shall be applied over top of masonry lintels. Bedjoints of lintels at control joints shall be underlaid with sheet metal bond breaker.

##### 3.7.4.2 Sill Flashing

Sill flashing shall extend the full width of the sill and not less than 4 inches beyond ends of sill except at control joint where the flashing shall be terminated at the end of the sill.

3.7.5 NOT USED

3.8 NOT USED

3.9 NOT USED

3.10 NOT USED

3.11 NOT USED

-- End of Section --

## SECTION C-07920

### JOINT SEALING

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509	(1994) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 920	(1995) Elastomeric Joint Sealants
ASTM C 1085	(1991) Butyl Rubber-Based Solvent-Release Sealants
ASTM D 1056	(1991) Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1565	(1981; R 1990) Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Open-Cell Foam)

##### 1.2 NOT USED

##### 1.3 ENVIRONMENTAL REQUIREMENTS

The ambient temperature shall be within the limits of 40 to 90 degrees F when the sealants are applied.

##### 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the job in the manufacturer's original unopened containers. The container label or accompanying data sheet shall include the following information as applicable: manufacturer, name of material, formula or specification number, lot number, color, date of manufacture, mixing instructions, shelf life, and curing time at the standard conditions for laboratory tests. Materials shall be handled and stored to prevent inclusion of foreign materials. Materials shall be stored at temperatures between 40 and 90 degrees F unless otherwise specified by the manufacturer.

#### PART 2 PRODUCTS

##### 2.1 BACKING

Backing shall be 25 to 33 percent oversize for closed cell and 40 to 50 percent oversize for open cell material, unless otherwise indicated.

###### 2.1.1 Rubber

A Cellular rubber sponge backing shall be ASTM D 1056, Type 2, closed cell, Class A, Grade RE-42, round cross section.

###### 2.1.2 PVC

B Polyvinyl chloride (PVC) backing shall be ASTM D 1565, Grade VO 12, open-cell foam, round cross section.

#### 2.1.3 Synthetic Rubber

C Synthetic rubber backing shall be ASTM C 509, Option I, Type I preformed rods or tubes.

#### 2.2 BOND-BREAKER

Bond-breaker shall be as recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

#### 2.3 PRIMER

Primer shall be non-staining type as recommended by sealant manufacturer for the application.

#### 2.4 NOT USED

#### 2.5 SEALANT

##### 2.5.1 NOT USED

##### 2.5.2 ELASTOMERIC

Elastomeric sealants shall conform to ASTM C 920 and the following:

- a. B Polysulfide Sealant: Type S, Grade NS, Class 25, Use NT, M, G, A, O.
- b. C Polyurethane Sealant: Grade NS or P, Class 25, Use T, NT, M, G, A, O.
- c. NOT USED
- d. NOT USED

##### 2.5.3 NOT USED

##### 2.5.4 BUTYL

G Butyl sealant shall be ASTM C 1085.

##### 2.5.5 PREFORMED

Preformed sealant shall be polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealant capable of sealing out moisture, air and dust when installed as recommended by the manufacturer. At temperatures from minus 30 to plus 160 degrees F, the sealant shall be non-bleeding and shall have no loss of adhesion.

##### 2.5.5.1 NOT USED

##### 2.5.5.2 NOT USED

##### 2.5.5.3 Foam Strip

J Foam strip shall be polyurethane foam; cross-section dimensions shall be 1/2 x 1/2 inch. Foam strip shall be capable of sealing out moisture, air, and dust when installed and compressed as recommended by the manufacturer. Service temperature shall be minus 40 to plus 275 degrees F. Untreated strips shall be furnished with adhesive to hold them in place. Adhesive shall not stain or bleed into adjacent finishes.

## 2.6 SOLVENTS AND CLEANING AGENTS

Solvents, cleaning agents, and accessory materials shall be provided as recommended by the manufacturer.

## PART 3 EXECUTION

### 3.1 GENERAL

#### 3.1.1 Surface Preparation

The surfaces of joints to receive sealant shall be free of all frost, condensation and moisture. Oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scale, and other foreign substances shall be removed from surfaces of joints to be in contact with the sealant. Oil and grease shall be removed with solvent and surfaces shall be wiped dry with clean cloths. For surface types not listed below, the sealant manufacturer shall be contacted for specific recommendations.

#### 3.1.2 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence and loose mortar shall be removed from the joint cavity.

#### 3.1.3 Steel Surfaces

Steel surfaces to be in contact with sealant shall be sandblasted or, if sandblasting would not be practical or would damage adjacent finish work, the metal shall be scraped and wire brushed to remove loose mill scale. Protective coatings on steel surfaces shall be removed by sandblasting or by a solvent that leaves no residue.

#### 3.1.4 Aluminum Surfaces

Aluminum surfaces to be in contact with sealants shall be cleaned of temporary protective coatings. When masking tape is used for a protective cover, the tape and any residual adhesive shall be removed just prior to applying the sealant. Solvents used to remove protective coating shall be as recommended by the manufacturer of the aluminum work and shall be non-staining.

#### 3.1.5 Wood Surfaces

Wood surfaces to be in contact with sealants shall be free of splinters and sawdust or other loose particles.

### 3.2 APPLICATION

#### 3.2.1 Masking Tape

Masking tape shall be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Masking tape shall be removed within 10 minutes after joint has been filled and tooled.

#### 3.2.2 Backing

Backing shall be installed to provide the indicated sealant depth. The installation tool shall be shaped to avoid puncturing the backing.

#### 3.2.3 Bond-Breaker

Bond-breaker shall be applied to fully cover the bottom of the joint without contaminating the sides where sealant adhesion is required.

#### 3.2.4 Primer

Primer shall be used on concrete masonry units, wood, or other porous surfaces in accordance with instructions furnished with the sealant. Primer shall be applied to the joint surfaces to be sealed. Surfaces adjacent to joints shall not be primed.

#### 3.2.5 Sealant

Sealant shall be used before expiration of shelf life. Multi-component sealants shall be mixed according to manufacturer's printed instructions. Sealant in guns shall be applied with a nozzle of proper size to fit the width of joint. Joints shall be sealed as detailed in the drawings. Sealant shall be forced into joints with sufficient pressure to expel air and fill the groove solidly. Sealant shall be installed to the indicated depth without displacing the backing. Unless otherwise indicated, specified, or recommended by the manufacturer, the installed sealant shall be dry tooled to produce a uniformly smooth surface free of wrinkles and to assure full adhesion to the sides of the joint; the use of solvents, soapy water, etc., will not be allowed. Sealants shall be installed free of air pockets, foreign embedded matter, ridges and sags. Sealer shall be applied over the sealant when and as specified by the sealant manufacturer.

#### 3.3 CLEANING

The surfaces adjoining the sealed joints shall be cleaned of smears and other soiling resulting from the sealant application as work progresses.

-- End of Section --



SECTION C-08110

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 236	(1989; R 1993) Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box
ASTM C 976	(1990) Thermal Performance of Building Assemblies by Means of a Calibrated Hot Box
ASTM D 2863	(1991) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

DOOR AND HARDWARE INSTITUTE (DHI)

DH A115.1G	(1994) Installation Guide for Doors and Hardware
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1995) Fire Doors and Windows
NFPA 80A	(1993) Protection of Buildings from Exterior Fire Exposures
NFPA 101	(1997) Safety to Life from Fire in Buildings and Structures
NFPA 252	(1995) Fire Tests of Door Assemblies

STEEL DOOR INSTITUTE (SDOI)

SDOI SDI 100	(1991) Standard Steel Doors and Frames
SDOI SDI 106	(1996) Standard Door Type Nomenclature
SDOI SDI 107	(1984) Hardware on Steel Doors (Reinforcement - Application)

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

#### SD-04 Drawings

Steel Doors and Frames; GA.

Drawings using standard door type nomenclature in accordance with SDOI SDI 106 and indicating the location of each door and frame, elevation of each model of door and frame, details of construction, method of assembling sections, location and extent of hardware reinforcement, hardware locations, type and location of anchors for frames, and thicknesses of metal. Drawings shall include catalog cuts or descriptive data for the doors, frames and weatherstripping including air infiltration data and manufacturer's printed instructions.

#### SD-09 Reports

Fire Rated Doors; GA.

In lieu of an Underwriters Laboratories, Inc. listing for fire doors assemblies, a letter shall be submitted by the testing laboratory which identifies the submitted product be manufacturer and type or model and certifies that it has tested a sample assembly and issued a current listing for same.

#### SD-13 Certificates

Thermal Insulated Doors; GA.

a. NOT USED

b. Certification of Thermal Insulating Rating: Certification or test report for thermal insulated doors shall show compliance with the specified requirements. The certification, or test report, shall list the parameters and the type of hardware and perimeter seals used to achieve the rating.

#### 1.3 DELIVERY AND STORAGE

During shipment, welded unit type frames shall be strapped together in pairs with heads at opposite ends or shall be provided with temporary steel spreaders at the bottom of each frame. Materials shall be delivered to the site in undamaged condition, and stored out of contact with the ground and under a weathertight covering permitting good air circulation. Doors and assembled frames shall be stored in an upright position in accordance with DHI A115.1G. Abraded, scarred, or rusty areas shall be cleaned and touched up with matching finishes.

#### 1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

## PART 2 PRODUCTS

### 2.1 DOORS AND FRAMES

Doors and frames shall be factory fabricated in accordance with SDOI SDI-100 and the additional requirements specified herein. Door grade shall be extra heavy duty unless otherwise indicated on the door and door frame schedules. Exterior doors and frames shall be galvanized. Indicated interior doors and frames shall be galvanized. Doors and frames shall be prepared to receive hardware conforming to the templates and information provided under Section C-08700 BUILDERS' HARDWARE. Doors and frames shall be reinforced, drilled, and tapped to receive mortised hinges, locks, latches, and flush bolts as required. Doors and frames shall be reinforced for surface applied hardware. Frames shall be welded type located as shown. Door frames shall be furnished with a minimum of three jamb anchors and one floor anchor per jamb. Anchors shall be not less than 18 gauge steel or 7 gauge diameter wire. For wall conditions that do not allow the use of a floor anchor, an additional jamb anchor shall be provided. Rubber silencers shall be furnished for installation into factory predrilled holes in door frames; adhesively applied silencers are not acceptable. Where frames are installed in plaster or masonry walls, plaster guards shall be provided on door frames at hinges and strikes. Reinforcing of door assemblies for closers and other required hardware shall be in accordance with SDOI SDI-100 and the conditions of the fire door assembly listing when applicable. Exterior doors shall have top edges closed flush and sealed against water penetration.

### 2.2 FIRE RATED DOORS

Fire rated door assemblies shall bear the listing identification label of a nationally recognized testing laboratory qualified to perform tests of fire door assemblies in accordance with NFPA 252 and having a listing for the tested assemblies. The fire resistance rating shall be as shown. Doors exceeding the sizes for which listing label service is offered shall be in accordance with NFPA 252. Listing identification labels shall be constructed and permanently applied by a method which results in their destruction should they be removed.

### 2.3 THERMAL INSULATED DOORS

The interior of thermal insulated doors shall be completely filled with rigid plastic foam permanently bonded to each face panel. The thermal conductance (U-value) through the door shall not exceed 0.24 when tested as an operational assembly in accordance with ASTM C 236 or ASTM C 976. Doors with cellular plastic cores shall have a minimum oxygen index rating of 22 percent when tested in accordance with ASTM D 2863.

### 2.4 NOT USED

### 2.5 NOT USED

### 2.6 WEATHERSTRIPPING

Unless otherwise specified in Section C-08700 BUILDERS' HARDWARE, weatherstripping shall be as follows: Weatherstripping for head and jamb shall be manufacturer's standard elastomeric type of synthetic rubber, vinyl, or neoprene and shall be installed at the factory or on the jobsite in accordance with the door frame manufacturer's recommendations. Weatherstripping for bottom of doors shall be as shown. Air leakage rate of weatherstripping shall not exceed 0.20 cfm per linear foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

### 2.7 TRANSOM AND SIDELIGHT PANELS

Panels for transom and sidelight shall be constructed in accordance with SDOI SDI-100. Panels shall be nonremovable from the outside of exterior doors or the unsecure side of interior doors.

## 2.8 LOUVERS

Where indicated, doors shall be provided with full louvers or louver sections. Louvers shall be sightproof type inserted into the door. Inserted louvers shall be stationary. Louvers shall be nonremovable from the outside of exterior doors or the unsecure side of interior doors. Insect screens shall be a removable type with 18 by 16 mesh aluminum or bronze cloth.

## 2.9 GLAZING

Glazing shall be as specified in Section C-08810 GLASS AND GLAZING. Removable glazing beads shall be screw-on or snap-on type.

## 2.10 NOT USED

# PART 3 EXECUTION

## 3.1 INSTALLATION

Installation shall be in accordance with DHI A115.1G. Preparation for surface applied hardware shall be in accordance with SDOI SDI-107. Rubber silencers shall be installed in door frames after finish painting has been completed; adhesively applied silencers are not acceptable. Weatherstripping shall be installed at exterior door openings to provide a weathertight installation. Installation and operational characteristics of fire doors shall be in accordance with NFPA 80, NFPA 80A and NFPA 101. Hollow metal door frames shall be solid grouted as shown.

### 3.1.1 Thermal Insulated Doors

Hardware and perimeter seals shall be adjusted for proper operation. Doors shall be sealed weathertight after installation of hardware and shall be in accordance with Section C-07920 JOINT SEALING.

### 3.1.2 NOT USED

### 3.1.3 NOT USED

## 3.2 FIELD PAINTED FINISH

Steel doors and frames shall be field painted in accordance with Section C-09900 PAINTING, GENERAL. Weatherstrips shall be protected from paint. Finish shall be free of scratches or other blemishes. Color shall be as shown.

-- End of Section --

## SECTION C-08330

### OVERHEAD ROLLING DOORS

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |            |   |
|------------|---|
| ASTM A 653 | (1996) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process          |
| ASTM E 84  | (1996a) Surface Burning Characteristics of Building Materials   |
| ASTM E 330 | (1990) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference |

##### AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS (ASHRAE)

- |           |   |
|-----------|---|
| ASHRAE-03 | (1993) Handbook, Fundamentals I-P Edition |
|-----------|---|

##### NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- |            |   |
|------------|---|
| NEMA ICS 2 | (1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More than 2,000 Volts AC or 750 Volts DC |
| NEMA ICS 6 | (1993) Industrial Control and Systems Enclosures  |
| NEMA MG 1  | (1993; Rev 1, Rev 2, Rev 3) Motors and Generators   |

##### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- |         |                                 |
|---------|---------------------------------|
| NFPA 70 | (1996) National Electrical Code |
|---------|---------------------------------|

##### 1.2 DESCRIPTION

Overhead rolling doors shall be spring counterbalanced, rolling type, with interlocking slats, complete with guides, fastenings, hood, brackets, and operating mechanisms, and shall be designed for use on openings as indicated. Each door shall be provided with a permanent label showing the manufacturer's name and address and the model/serial number of the door.

##### 1.2.1 Wind Load Requirements

Doors and components shall be designed to withstand the minimum design wind load of 20 psf. Doors shall be constructed to sustain a superimposed load, both inward and outward, equal to 1-1/2 times the minimum design wind load. The door shall support the superimposed loads for a minimum period of 10 seconds without evidence of serious damage and shall be operable after conclusion of the tests.

Test data showing compliance with design windload requirements for the door design tested in accordance with a uniform static load equal to 1-1/2 times the minimum design windload, shall be provided. The uniform static load test specimen shall be supported using guides, endlocks, and windlocks as required for project installation. Recovery shall be at least 3/4 of the maximum deflection within 24 hours after the test load is removed.

#### 1.2.2 Operational Cycle Life

All portions of the door and door operating mechanism that are subject to movement, wear, or stress fatigue shall be designed to operate through a minimum of 100,000 cycles. One complete cycle of door operation is defined as when the door is in the closed position, moves to the full open position and returns to the closed position.

#### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-01 Data

Overhead Rolling Door Unit; FIO.

Manufacturer's catalog data, test data, and summary of forces and loads on the walls/jambs.

##### SD-04 Drawings

Overhead Rolling Door Unit; GA.

Drawings shall include elevations of each door type, details and method of anchorage, details of construction, location and installation of hardware, shape and thickness of materials, details of joints and connections, and details of guides, power operators, controls, and other fittings.

##### SD-06 Instructions

Overhead Rolling Door Unit; FIO.

Manufacturer's preprinted installation instructions.

##### SD-19 Operation and Maintenance Manuals

Operation Manual; FIO.

Maintenance and Repair Manual; FIO.

Six copies of the system operation manual and system maintenance and repair manual for each type of door and control system.

#### 1.4 DELIVERY AND STORAGE

Doors shall be delivered to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Doors shall be stored in a dry location that is adequately ventilated and free from dirt and dust, water, and other contaminants, and in a manner that permits easy access for inspection and handling.

#### 1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

## 1.6 OPERATION AND MAINTENANCE MANUALS

Operating instructions outlining the step-by-step procedures required for motorized door and shutter operation for the overhead rolling door unit shall be provided. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, troubleshooting guides, and simplified diagrams for the equipment as installed shall be provided. A complete list of parts and supplies, source of supply, and a list of the high mortality maintenance parts shall be provided.

## PART 2 PRODUCTS

### 2.1 OVERHEAD ROLLING DOORS

Doors shall be surface-mounted type with guides at jambs set back a sufficient distance to clear the opening. Exterior doors shall be mounted as indicated.

#### 2.1.1 Curtains

The curtains shall roll up on a barrel supported at the head of opening on brackets, and shall be balanced by helical torsion springs. Steel slats for doors 21 feet wide and wider shall be minimum bare metal thickness of 0.0438 inches (18 gauge). Slats shall be of the minimum bare metal decimal thickness required for the width indicated and the wind pressure specified above.

##### 2.1.1.1 NOT USED

##### 2.1.1.2 Insulated Curtains

The slat system shall supply a minimum R-value of 5 when calculated in accordance with ASHRAE-03. Slats shall be of the flat type as standard with the manufacturer. Slats shall consist of a urethane core not less than 11/16 inch thick, completely enclosed within metal facings. Exterior face of slats shall be gauge as specified for curtains. Interior face shall be not lighter than 0.0209 inches. The insulated slat assembly shall have a flame spread rating of not more than 25 and a smoke development factor of not more than 50 when tested in accordance with ASTM E 84.

#### 2.1.2 Endlocks and Windlocks

The ends of each alternate slat for exterior doors shall have steel endlocks of manufacturer's stock design. In addition to endlocks, non-rated exterior doors shall have the manufacturer's standard windlocks as required to withstand the wind load. Windlocks shall prevent the curtain from leaving guides because of deflection from specified wind pressure.

#### 2.1.3 Bottom Bar

The curtain shall have a standard bottom bar consisting of two hot-dip galvanized steel angles for steel doors. A sensing edge shall be attached to the bottom bar of doors that are electric-power operated.

#### 2.1.4 Guides

Guides shall be steel structural shapes or formed steel shapes, of a size and depth to provide proper clearance for operation and resistance under the design windload. Guides shall be attached to adjoining construction with fasteners

recommended by the manufacturer. Spacing of fasteners shall be as required to meet the minimum design windload.

#### 2.1.5 Barrel

The barrel shall be steel pipe or commercial welded steel tubing of proper diameter for the size of curtain. Deflection shall not exceed 0.03 inch per foot of span. Ends of the barrel shall be closed with cast-iron or steel plugs, machined to fit the pipe.

#### 2.1.6 Springs

Oil tempered helical steel counter-balance torsion springs shall be installed within the barrel and shall be capable of producing sufficient torque to assure easy operation of the door curtain. Access shall be provided for spring tension adjustment from outside of the bracket without removing the hood.

#### 2.1.7 Brackets

Brackets shall be of steel plates to close the ends of the roller-shaft housing, and to provide mounting surfaces for the hood. An operation bracket hub and shaft plugs shall have sealed prelubricated ball bearings.

#### 2.1.8 Hoods

Hoods shall be steel, with minimum bare metal thickness of 0.0209 inches, formed to fit contour of the end brackets, and shall be reinforced with steel rods, rolled beads, or flanges at top and bottom edges. Multiple segment and single piece hoods shall be provided with support brackets of the manufacturer's standard design as required for adequate support.

#### 2.1.9 Weatherstripping

Exterior doors shall be fully weatherstripped. A compressible and replaceable weather seal shall be attached to the bottom bar. Weather seal at door guides shall be continuous vinyl or neoprene, bulb or leaf type, or shall be nylon-brush type. A weather baffle shall be provided at the lintel or inside the hood. Weatherstripping shall be easily replaced without special tools.

#### 2.1.10 NOT USED

#### 2.1.11 Operation

Doors shall be operated by means of electric power with auxiliary chain hoist.

##### 2.1.11.1 NOT USED

##### 2.1.11.2 NOT USED

##### 2.1.11.3 NOT USED

##### 2.1.11.4 Electric Power Operator With Auxiliary Chain Hoist Operation

Electric power operators shall be heavy-duty industrial type. The unit shall operate the door through the operational cycle life specified. The electric power operator shall be complete with electric motor, auxiliary operation, necessary means of reduction, brake, mounting brackets, push button controls, limit switches, magnetic reversing starter, and all other accessories necessary to operate components specified in other paragraphs of this section. The operator shall be so designed that the motor may be removed without disturbing the limit-switches settings and without affecting the emergency chain operator. Doors shall be provided with an auxiliary operator for immediate emergency manual



operation of the door in case of electrical failure. The emergency manual operating mechanism shall be so arranged that it may be operated from the floor without affecting the settings of the limit switches. A mechanical device shall be included that will disconnect the motor from the drive operating mechanism when the auxiliary operator is used. Where control voltages differ from motor voltage, a control voltage transformer shall be provided in and as part of the electric power operator system. Control voltage shall not exceed 120 volts.

a. Motors: Drive motors shall conform to NEMA MG 1, shall be high-starting torque, reversible type, and shall be of sufficient horsepower and torque output to move the door in either direction from any position at a speed range of 6 to 8 inches per second without exceeding the rated capacity. Motors shall be suitable for operation on 208 volts, 60 hertz, 3-phase current and shall be suitable for across-the-line starting. Motors shall be designed to operate at full capacity over a supply voltage variation of plus or minus 10 percent of the motor voltage rating. Motors shall be provided with overload protection.

b. Controls: Control equipment shall conform to NEMA ICS 2. Enclosures shall conform to NEMA ICS 6, Type 12 (industrial use), in accordance with NFPA 70. Exterior control stations shall be weatherproof key-operated type with corrosion-resistant cast-metal cover. Each control station shall be of the three position button type, marked "OPEN," "CLOSE," and "STOP." The "OPEN" and "STOP" controls shall be of the momentary contact type with seal-in contact. The "CLOSE" control shall be of the momentary contact type. When the door is in motion and the "STOP" control is pressed, the door shall stop instantly and remain in the stop position; from the stop position, the door shall be operable in either direction by the "OPEN" or "CLOSE" controls. Controls shall be of the full-guarded type to prevent accidental operation. Readily adjustable limit switches shall be provided to automatically stop the doors at their fully open and closed positions.

c. Sensing Edge Device: The bottom edge of electric power operated doors shall have an electric sensing edge that will immediately reverse the door movement upon contact with an obstruction and cause the door to return to its full open position. The sensing edge shall not substitute for a limit switch. Exterior doors shall be provided with a combination compressible weather seal and sensing edge.

d. Electrical Work: Conduit and wiring necessary for proper operation shall be provided under Section C-16415 ELECTRICAL WORK, INTERIOR. Flexible connections between doors and fixed supports shall be made with extra flexible type SJO cable, except in hazardous locations where wiring shall conform to NFPA 70. The cable shall have a spring-loaded automatic take up reel or a coil cord equivalent device.

#### 2.1.12 Inertia Brake

Overhead rolling door shall have a mechanical inertia brake device which will stop the door from free fall in any position, should there be a failure in the motor operator brake or roller chain drive. The unit shall be capable of being reset with a back drive action.

#### 2.1.13 Locking

Locking for motor operated doors shall consist of self-locking gearing with chain lock for emergency hand chain.

#### 2.1.14 Finish

Steel slats and hoods shall be hot-dip galvanized G60 in accordance with ASTM A 653, and shall be treated for paint adhesion and shall receive a baked on prime coat for field finishing. The paint system shall withstand a minimum of 1500

hours without blistering, bubbling, or rust. Surfaces other than slats, hood, and faying surfaces shall be cleaned and treated to assure maximum paint adherence and shall be given a factory dip or spray coat of rust inhibitive metallic oxide or synthetic resin primer. Color shall be in accordance with the Color Schedule shown on the Drawings.

## 2.2 NOT USED

## PART 3 EXECUTION

### 3.1 INSTALLATION

Doors shall be installed in accordance with approved detail drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, motors, switches, hardware, and other accessories shall be accurately located. Upon completion, doors shall be free from warp, twist, or distortion. Doors shall be lubricated, properly adjusted, and demonstrated to operate freely.

### 3.2 FIELD PAINTED FINISH

Steel doors and frames shall be field painted in accordance with Section C-09900 PAINTING, GENERAL. Weatherstrips shall be protected from paint. Finish shall be free of scratches or other blemishes. Color shall be in accordance with COLOR SCHEDULE as shown on Drawings.

### 3.3 NOT USED

-- End of Section --

SECTION C-08331

METAL ROLLING COUNTER DOORS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 653 (1995) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1995) Fire Doors and Windows

1.2 GENERAL

Rolling counter doors shall be fire-rated of the type, size, and design indicated on the drawings, and shall be the standard product of a manufacturer regularly engaged in the production of rolling counter doors. Each door shall be provided with a permanent label showing the manufacturer's name and address and the model number of the door.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-01 Data

Rolling Counter Door Unit; FIO.

Manufacturer's descriptive data and catalog cuts.

SD-04 Drawings

Rolling Counter Door Unit; FIO.

Drawings including elevations of each door type, details of anchorage, details of construction, location and installation of hardware, shape and thickness of materials, details of joints and connections, and details of guides and fittings. A schedule showing the location of each counter door shall be included with the drawings.

SD-06 Instructions

Rolling Counter Door Unit; FIO.

Manufacturer's preprinted installation instructions.

SD-19 Operation and Maintenance Manuals

Rolling Counter Door Unit; FIO.

Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, troubleshooting guides, and simplified diagrams for the equipment as installed. Spare parts data for each different item of material and equipment specified not later than 1 month prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 year and 3 years of service.

#### 1.4 DELIVERY AND STORAGE

Rolling counter doors shall be delivered to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Rolling counter doors shall be stored in a dry location that is adequately ventilated and free from dust, water, or other contaminants, and in a manner that permits easy access for inspecting and handling. Doors shall be handled carefully to prevent damage. Damaged items that cannot be restored to like-new condition shall be replaced.

### PART 2 PRODUCTS

#### 2.1 BASIC COMPONENTS

##### 2.1.1 Curtain

The curtain shall be fabricated of galvanized steel slats conforming to ASTM A 653, Coating Designation G60. Slats shall be approximately 1-1/4 to 1-1/2 inch wide with a depth of crown of 1/2 inch. Alternate slats shall be fitted with end locks to maintain curtain alignment. Bottom of curtain shall be provided with angle or tubular bar reinforcement matching the curtain, and fitted with a resilient bottom seal.

##### 2.1.2 Jamb Guides

Guides shall be of 13 gauge minimum thickness galvanized steel angles conforming to ASTM A 653, Coating Designation G60.

##### 2.1.3 Barrel

The curtain shall be coiled around a steel tube of sufficient thickness and diameter to prevent deflection exceeding 0.03 inch per foot. The barrel shall contain oil tempered torsion springs capable of counterbalancing the weight of the curtain. Springs shall be calculated to provide a minimum of 7,500 operating cycles (one complete cycle of door operation will begin with the door in the closed position, move to the full open position and return to the closed position).

##### 2.1.4 Counterbalance Assembly

Spring counterbalance shall be helical torsion type designed to include an overload factor of 25 percent and shall be grease packed and mounted in an inner shaft rod with grease sealed ball bearing units at each end.

##### 2.1.5 Brackets

Brackets shall be a minimum 1/8 inch thick steel plate with provisions for bolting to the wall or to the guides.

##### 2.1.6 Hood

The hood shall be of 24 gauge galvanized steel conforming to ASTM A 653, Coating Designation G60.

#### 2.1.7 Locks

The curtain shall be locked at each side of the bottom bar by an integral slide bolt suitable for padlocks by others. Padlock shall be on the room side of the counter door.

#### 2.2 NOT USED

#### 2.3 FIRE-RATED ROLLING COUNTER DOOR

Fire-rated rolling counter doors shall be Class B (1-1/2 hr.) rated and shall conform to the requirements specified and to NFPA 80 for the class indicated. Doors shall bear the labels of a recognized testing agency indicating the applicable fire resistance rating. The construction details necessary for labeled rolling counter doors shall take precedence over details indicated or specified herein. Door curtains, guides and hood shall be galvanized steel. Fire-rated rolling counter doors shall be complete with hardware, accessories, and automatic closing device.

#### 2.4 NOT USED

#### 2.5 OPERATION

##### 2.5.1 Manual Operation

The curtain shall be operated by means of manual push-up with lift handles or continuous full width lift bar.

##### 2.5.2 NOT USED

#### 2.6 AUTOMATIC CLOSING DEVICE

Fire-rated counter doors shall be equipped with an automatic closing device which shall operate upon activation of the building's fire alarm system.

#### 2.7 FINISH

Exposed parts of the counter door, including the curtain, bottom rail, guides, and hood shall be of uniform finish and appearance. Steel shall have galvanized coating and shall be given a prime coat of paint as standard with the manufacturer. Steel parts that are not exposed shall be given a shop coat of paint standard with the manufacturer.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Doors shall be installed in accordance with approved detail drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, hardware, and other accessories shall be accurately located. Upon completion, doors shall be free from warp, twist, or distortion. Doors shall be lubricated, properly adjusted, and demonstrated to operate freely. Fire-door installation shall be in conformance with NFPA 80 for the class indicated and the manufacturer's instructions.

#### 3.2 FIELD FINISHING

Doors to receive field finishing shall be factory primed, as required, and then shall be finished in accordance with Color Schedule. Color shall be equivalent to a computer match of the colors indicated.

--END OF SECTION--



SECTION C-08510

STEEL WINDOWS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 569	(1991a; R 1993) Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality
ASTM A 653	(1994) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot- Dip Process
ASTM A 924	(1994) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 766	(1986; R 1993) Electrodeposited Coatings of Cadmium
ASTM C 236	(1989; R 1993) Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box
ASTM E 283	(1991) Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 330	(1990) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E 331	(1993) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.6.3	(1972; R 1991) Machine Screws and Machine Screw Nuts
ASME B18.6.4	(1981; R 1991) Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws (Inch Series)

INSECT SCREENING WEAVERS ASSOCIATION (ISWA)

ISWA IWS 089	(1990) Recommended Standards and Specifications for Insect Screening
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SCREEN MANUFACTURERS ASSOCIATION (SMA)

## STEEL WINDOW INSTITUTE (SWI)

SWI-01 (1989) The Specifier's Guide to Steel Windows

## 1.2 WINDOW PERFORMANCE

Steel windows shall be designed to meet the following performance requirements, and shall be of the type and size indicated.

## 1.2.1 Structural Performance

Structural test pressures on window units shall be for positive load (inward) and negative load (outward) in accordance with ASTM E 330. After testing, there shall be no glass breakage, permanent damage to fasteners, hardware parts, support arms or actuating mechanisms or any other damage which could cause window to be inoperable. There shall be no permanent deformation of any main frame, sash or ventilator member in excess of the requirements established by SWI-01 for the window types specified in this section.

## 1.2.2 Air Infiltration

Air infiltration shall not exceed the amount established by SWI-01 for each window type when tested in accordance with ASTM E 283.

## 1.2.3 Water Penetration

Water penetration shall not exceed the amount established by SWI-01 for each window type when tested in accordance with ASTM E 331.

## 1.2.4 Thermal Performance

Thermal resistance shall meet requirements established by ASTM C 236.

## 1.2.5 NOT USED

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

## SD-04 Drawings

Steel Windows; GA.

Insect Screens; GA.

Drawings indicating elevations of windows, rough-opening dimensions for each type and size of windows, full-size sections, thicknesses of metal, fastenings, methods of installation and anchorage, connections with other work, type of wall construction, size and spacing of anchors, method of glazing, types and locations of operating hardware, mullion details, weatherstripping details, screen details including method of attachment, and window schedules showing locations of each window type.

## 1.4 QUALIFICATION

Window manufacturer shall specialize in designing and manufacturing the type of steel windows specified, and shall have a minimum of 5 years of documented



successful experience. Manufacturer shall have the facilities capable of meeting contract requirements, single-source responsibility and warranty.

#### 1.5 NOT USED

#### 1.6 DELIVERY AND STORAGE

Steel windows shall be delivered to project site and stored in accordance with manufacturer's recommendations. Damaged windows shall be replaced with new windows.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

##### 2.1.1 Steel Bars

Steel bars shall be solid one-piece sections hot-rolled from new billet steel in accordance with SWI-01.

##### 2.1.2 Sheet Steel

Hot-rolled sheet steel shall conform to ASTM A 569, commercial quality with a minimum of 0.15 percent carbon. Sheet steel shall be zinc coated (galvanized) by the hot-dip process in accordance with ASTM A 653 or ASTM A 924.

##### 2.1.3 Screws and Bolts

Screws and bolts shall conform to ASTM B 766, ASME B18.6.3 and ASME B18.6.4.

#### 2.2 STEEL WINDOW TYPES

Steel windows shall be designed for inside field glazing, and for glass types scheduled on drawings and specified in Section \08810 GLASS AND GLAZING. Units shall be complete with glass and glazing provisions to meet requirements of paragraph WINDOW PERFORMANCE and SWI-01. Glazing material shall be compatible with steel, and shall not require painting.

##### 2.2.1 Projected Windows

Steel projected windows shall conform to SWI-01 Heavy Custom type. Hinges for projected windows shall be concealed four-bar friction type. Sash locks for project-out ventilators shall be cam-action sweep-lock handle with surface-mounted strike. Limit stops shall be provided for project-out ventilators that open onto traffic areas. Ventilator operation shall permit cleaning the outside face of glass from inside the building.

##### 2.2.2 NOT USED

##### 2.2.3 NOT USED

#### 2.3 WEATHERSTRIPPING

Weatherstripping for ventilating sections shall be designed to meet water penetration and air infiltration requirements specified under paragraph WINDOW PERFORMANCE in accordance with SWI-01, and shall be manufactured of material compatible with steel and resistant to weather. Weatherstrips shall be factory-applied and easily replaced in the field. Neoprene or polyvinylchloride weatherstripping are not acceptable where exposed to direct sunlight.

#### 2.4 INSECT SCREENS

Insect screens shall be steel window manufacturer's standard design, and shall be provided where scheduled on drawings. Insect screens shall be fabricated of roll-formed galvanized steel frames conforming to SMA 1004 (18 x 16) corrosion-resistant steel mesh screening conforming to ISWA IWS 089.

## 2.5 ACCESSORIES

### 2.5.1 Fasteners

Fastening devices shall be window manufacturer's standard design made from non-magnetic stainless steel, cadmium-plated steel, zinc-plated steel, nickel/chrome-plated steel or magnetic stainless steel in compliance with SWI-01. Self-tapping sheet metal screws are not acceptable for material thicker than 1/16 inch.

### 2.5.2 Window Anchors

Anchors for installing windows shall be stainless steel or hot-dip zinc coated steel conforming to ASTM A 123.

### 2.5.3 NOT USED

### 2.5.4 NOT USED

## 2.6 FINISHES

### 2.6.1 Prime Coat

Steel windows, fins, mullions, cover plates and associated parts shall be cleaned, treated and factory-primed with manufacturer's standard primer coat in a dry film thickness of not less than 1.0 mil. Primer coat shall be free of scratches and other blemishes. Paint finish shall be in accordance with paragraph FIELD PAINTED FINISH.

### 2.6.2 NOT USED

### 2.6.3 NOT USED

### 2.6.4 NOT USED

## PART 3 EXECUTION

### 3.1 INSTALLATION

Steel windows shall be installed in accordance with approved shop drawings and manufacturer's approved recommendations. Steel surfaces in close proximity with masonry, concrete, wood, and dissimilar metals other than stainless steel, zinc, cadmium, or small areas of white bronze shall be protected from direct contact. The completed window installation shall be watertight and shall be in accordance with Section C-07920, JOINT SEALING. Glazing shall be installed in accordance with requirements of this section and Section C-08810, GLASS AND GLAZING.

### 3.2 ADJUSTMENTS AND CLEANING

#### 3.2.1 Hardware Adjustments

Final operating adjustments shall be made after glazing work is complete. When adjustments are completed, operating sash or ventilators shall operate smoothly, and shall be weathertight when locked in closed position.

#### 3.2.2 Cleaning

Steel window finish and glass shall be cleaned on interior and exterior sides in accordance with window manufacturer's recommendations. Alkaline or abrasive agents shall not be used.

### 3.3 FIELD-PAINTED FINISH

Steel windows shall be field-painted in accordance with Section C-09900, PAINTING, GENERAL. Weatherstrips shall be protected from paint. Finish shall be free of scratches and other blemishes. Color shall be in accordance with the Color Schedule shown on the Drawings.

-- End of Section -- 4

SECTION C-08520

ALUMINUM SLIDING SERVICE WINDOW

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1980) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 101 (1993) Voluntary Specifications for Aluminum Prime Windows and Sliding Glass Doors

1.2 NOT USED

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-01 Data

Aluminum Windows; FIO.

Manufacturer's descriptive data and catalog cut sheets.

SD-04 Drawings

Aluminum Windows; GA.

Drawings indicating elevations of window, rough-opening dimensions for each type and size of window, full-size sections, thicknesses of metal, fastenings, methods of installation and anchorage, connections with other work, type of wall construction, size and spacing of anchors, method of glazing, types and locations of operating hardware and weatherstripping details.

SD-06 Instructions

Aluminum Windows; FIO.

Manufacturer's preprinted installation instructions and cleaning instructions.

1.4 QUALIFICATION

Window manufacturer shall specialize in designing and manufacturing the type of aluminum windows specified in this section, and shall have a minimum of 5 years of documented successful experience. Manufacturer shall have the facilities

capable of meeting contract requirements, single-source responsibility and warranty.

#### 1.5 NOT USED

#### 1.6 DELIVERY AND STORAGE

Aluminum windows shall be delivered to project site and stored in accordance with manufacturer's recommendations. Damaged windows shall be replaced with new windows.

#### 1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

### PART 2 PRODUCTS

#### 2.1 ALUMINUM WINDOW TYPES

Aluminum window shall consist of complete units including sash, glass, frame, weatherstripping, and hardware. Window shall conform to AAMA 101. Window shall be single-glazed.

##### 2.1.1 NOT USED

##### 2.1.2 NOT USED

##### 2.1.3 Single-Hung Windows

Aluminum single hung sliding service windows shall be heavy commercial type which operate vertically. They shall be designed such that they are surface mounted with no obstructions or grooves in the counter. They shall be manufactured of heavy type 6063-T5 aluminum extrusions. They shall operate vertically with the weight of the sash offset by a counterbalancing spring mechanism mounted in the window to hold the sash stationary at any open position. Windows shall be provided with sliding bolt or pin type keyless locking devices to secure sash in closed position. Counterbalancing mechanisms shall be easily replaced after installation.

##### 2.1.4 NOT USED

##### 2.1.5 NOT USED

##### 2.1.6 NOT USED

##### 2.1.7 NOT USED

##### 2.1.8 NOT USED

#### 2.2 WEATHERSTRIPPING

Weatherstripping for ventilating sections shall be manufactured of material compatible with aluminum. Weatherstrips shall be factory-applied.

#### 2.3 NOT USED

#### 2.4 ACCESSORIES

##### 2.4.1 Fasteners

Fastening devices shall be window manufacturer's standard design made from aluminum, non-magnetic stainless steel, cadmium-plated steel, nickel/chrome-plated steel or magnetic stainless steel in compliance with AAMA 101. Self-tapping sheet metal screws will not be acceptable for material thicker than 1/16 inch.

#### 2.4.2 Hardware

Hardware shall be as specified for each window type and shall be fabricated of aluminum, stainless steel, cadmium-plated steel, zinc-plated steel or nickel/chrome-plated steel of quality established by AAMA 101.

#### 2.4.3 Window Anchors

Anchoring devices for installing windows shall be made of aluminum, cadmium-plated steel, stainless steel, or zinc-plated steel conforming to AAMA 101.

#### 2.4.4 NOT USED

### 2.5 GLASS AND GLAZING

Aluminum windows shall be designed for glass types scheduled on drawings and specified in Section C-08810 GLASS AND GLAZING. Units shall be complete with glass and glazing provisions to meet AAMA 101. Glazing material shall be compatible with aluminum, and shall not require painting.

#### 2.6 FINISH

##### 2.6.1 NOT USED

##### 2.6.2 Baked-Acrylic Resin-Based Coating

Exposed surfaces of aluminum windows shall be finished with acrylic resin-based coating conforming to AAMA 603.8, total dry thickness of 1.0 dry mils. Finish shall be free of scratches and other blemishes.

##### 2.6.3 NOT USED

##### 2.6.4 Color

Color shall be in accordance with Special Item Schedule, item 14, on sheet A-6.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Aluminum windows shall be installed in accordance with approved shop drawings and manufacturer's published instructions. Aluminum surfaces in contact with masonry, concrete, wood and dissimilar metals other than stainless steel, zinc, cadmium or small areas of white bronze, shall be protected from direct contact using protective materials recommended by AAMA 101. Glass and glazing shall be installed in accordance with requirements of this section and Section C-08810 GLASS AND GLAZING.

#### 3.2 ADJUSTMENTS AND CLEANING

##### 3.2.1 Hardware Adjustments

Final operating adjustments shall be made after glazing work is complete. Operating sash or ventilators shall operate smoothly.

##### 3.2.2 Cleaning

Aluminum window finish and glass shall be cleaned in accordance with window manufacturer's recommendations. Alkaline or abrasive agents shall not be used. Precautions shall be taken to avoid scratching or marring window finish and glass surfaces.

-- End of Section --

SECTION C-08700

BUILDERS' HARDWARE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |            |   |
|------------|---|
| ASTM E 283 | (1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen |
| ASTM F 833 | (1990) Padlocks   |

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

- |                        |  |
|------------------------|--|
| BHMA-01                | (Effective thru Jun 1995) Directory of Certified Locks & Latches |
| BHMA-02                | (Effective thru Jul 1995) Directory of Certified Door Closers    |
| BHMA-03                | (Effective thru Jul 1996) Directory of Certified Exit Devices    |
| BHMA ANSI/BHMA A156.1  | (1988) Butts and Hinges  |
| BHMA ANSI/BHMA A156.2  | (1989) Bored and Preassembled Locks and Latches                  |
| BHMA ANSI/BHMA A156.3  | (1994) Exit Devices  |
| BHMA ANSI/BHMA A156.4  | (1992) Door Controls - Closers                                   |
| BHMA ANSI/BHMA A156.5  | (1992) Auxiliary Locks & Associated Products                     |
| BHMA ANSI/BHMA A156.6  | (1994) Architectural Door Trim                                   |
| BHMA ANSI/BHMA A156.7  | (1988) Template Hinge Dimensions                                 |
| BHMA ANSI/BHMA A156.13 | (1994) Mortise Locks & Latches                                   |
| BHMA ANSI/BHMA A156.16 | (1989) Auxiliary Hardware  |
| BHMA ANSI/BHMA A156.18 | (1993) Materials and Finishes                                    |
| BHMA ANSI/BHMA A156.21 | (1989) Thresholds  |

DOOR AND HARDWARE INSTITUTE (DHI)

- |        |   |
|--------|---|
| DHI-03 | (1989) Keying Systems and Nomenclature  |
| DHI-04 | (1976) Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames |



DHI-05 (1990) Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames

DHI-A115.IG (1994) Installation Guide for Doors and Hardware

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1995) Fire Doors and Windows

NFPA 101 (1997) Safety to Life from Fire in Buildings and Structures

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

### SD-01 Data

Hardware and Accessories; GA.

Manufacturer's descriptive data, technical literature, catalog cuts, and installation instructions. Spare parts data for locksets, exit devices, and closers, after approval of the detail drawings, and not later than 1 month prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

### SD-07 Schedules

Hardware Schedule; GA.

Hardware schedule listing all items to be furnished. The schedule shall include for each item: the quantities; manufacturer's name and catalog numbers; the ANSI number specified; sizes; detail information or catalog cuts; finishes; door and frame size and materials; location and hardware set identification cross-references to drawings; corresponding reference standard type number or function number from manufacturer's catalog if not covered by ANSI or BHMA; and list of abbreviations and template numbers.

Keying Schedule; GA.

Keying schedule developed in accordance with DHI-03, after the keying meeting with the user.

The hardware manufacturer's certificates of compliance stating that the supplied material or hardware item meets specified requirements. Each certificate shall be signed by an official authorized to certify in behalf of the product manufacturer and shall identify quantity and date or dates of shipment or delivery to which the certificates apply. A statement that the proposed hardware items appear in BHMA-01 and BHMA-02 and BHMA-03 directories of certified products may be submitted in lieu of certificates.

## 1.3 PREDELIVERY CONFERENCE

Upon approval of the Hardware Schedule, the construction Contractor shall arrange a conference with the hardware supplier, Contracting Officer and the using agency to determine keying system requirements. Location of the key control storage system, set-up and key identification labeling will also be determined.

## 1.4 DELIVERY, STORAGE, AND HANDLING

Hardware shall be delivered to the project site in the manufacturer's original packages. Each article of hardware shall be individually packaged in the manufacturer's standard commercial carton or container, and shall be properly marked or labeled to be readily identifiable with the approved hardware schedule. Each change key shall be tagged or otherwise identified with the door for which its cylinder is intended. Where double cylinder functions are used or where it is not obvious which is the key side of a door, appropriate instructions shall be included with the lock and on the hardware schedule. Manufacturer's printed installation instructions, fasteners, and special tools shall be included in each package.

#### 1.5 SPECIAL TOOLS

Special tools, such as those supplied by the manufacturer, unique wrenches, and dogging keys, shall be provided as required to adjust hardware items.

#### 1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

#### 1.7 OPERATION AND MAINTENANCE MANUALS

Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides shall be provided.

### PART 2 PRODUCTS

#### 2.1 GENERAL HARDWARE REQUIREMENTS

Hardware shall conform to the requirements specified herein and the HARDWARE SETS listing at the end of this section. Hardware set numbers correspond to the set numbers shown on the drawings.

#### 2.2 TEMPLATES

Requirements for hardware to be mounted on metal doors or metal frames shall be coordinated between hardware manufacturer and door or frame manufacturer by use of templates and other information to establish location, reinforcement required, size of holes, and similar details. Templates of hinges shall conform to BHMA ANSI/BHMA A156.7.

#### 2.3 HINGES

Hinges shall conform to BHMA ANSI/BHMA A156.1. Hinges used on metal doors and frames shall also conform to BHMA ANSI/BHMA A156.7. Except as otherwise specified, hinge sizes shall conform to the hinge manufacturer's printed recommendations. Hinges shall have the following finish: 630.

##### 2.3.1 Hinges for Reverse Bevel Doors with Locks

Hinges for reverse bevel doors with locks shall have pins that are made nonremovable by means such as a set screw in the barrel, or safety stud, when the door is in the closed position.

##### 2.3.2 Contractor's Option

Hinges with antifriction bearings may be furnished in lieu of ball bearing hinges, except where prohibited for fire doors by the requirements of NFPA 80.

##### 2.3.3 NOT USED

2.3.4 NOT USED

2.3.5 NOT USED

## 2.4 LOCKS AND LATCHES

To the maximum extent possible, locksets, latchsets and deadlocks shall be the products of a single manufacturer. Finish for main entrance door lock and trim shall be 630. Finish for other door locks, latches and trim shall be 626.

### 2.4.1 Mortise Lock and Latchsets

Mortise lock, latchsets, and strikes shall be series 1000 and shall conform to BHMA ANSI/BHMA A156.13, operational Grade 1. Mortise type locks and latches for doors 1-3/4 inches thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door. Mortise locks shall have armored fronts. All deadbolts shall have a 1 inch throw.

### 2.4.2 Bored Lock and Latchsets

Bored lock, latchsets, and strikes shall be series 4000 and shall conform to BHMA ANSI/BHMA A156.2, Grade 1. Bored type locks and latches for doors 1-3/8 inches thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door.

2.4.3 NOT USED

2.4.4 NOT USED

### 2.4.5 Lock Cylinders (Mortise, Rim and Bored)

Lock cylinders shall comply with BHMA ANSI/BHMA A156.5. Locks shall be interchangeable and compatible with the best lock system currently utilized at this base. Lock cylinder shall have not less than six pins. Construction interchangeable cores shall be provided. Disassembly of knob or lockset shall not be required to remove core from lockset. All locksets, lockable exit devices, and padlocks shall accept same interchangeable cores.

2.4.6 NOT USED

### 2.4.7 Padlocks

Padlocks shall conform to ASTM F883. Straps, tee hinges and hasps shall conform to BHMA ANSI/BHMA A156.20. Padlocks shall be grade 4 with a 1-1/2" shackle height. Hasps shall be safety type.

2.4.8 NOT USED

### 2.4.9 Lock Trim

Lock trim shall be cast, forged, or heavy wrought construction of commercial plain design. In addition to meeting the test requirement of BHMA ANSI/BHMA A156.2 or BHMA ANSI/BHMA A156.13, knobs, lever handles, roses, and escutcheons shall be 0.050 inch thick, if unreinforced. If reinforced, the outer shell shall be 0.035 inch thick and the combined thickness shall be 0.070 inch except that knob shanks shall be 0.060 inch thick. Knob diameter shall be 2-1/8 to 2-1/4 inches. Lever handles shall be of plain design with ends returned to no more than 1/2 inch from the door face.

2.4.10 NOT USED

## 2.5 EXIT DEVICES AND EXIT DEVICE ACCESSORIES

Exit devices and exit device accessories shall conform to BHMA ANSI/BHMA A156.3, Grade 1. Finish shall be 630.

#### 2.5.1 Exit Devices and Auxiliary Items

Trim shall be of wrought construction and commercial plain design with straight, beveled, or smoothly rounded sides, corners, and edges. Adjustable strikes shall be provided for rim type and vertical rod devices. Open back strikes shall be provided for pairs of doors with mortise and vertical rod devices; except open back strikes shall be used on labeled doors only where specifically provided for in the published listings. Touch bars shall be provided in lieu of conventional crossbars and arms. Escutcheons shall be provided not less than 7 by 2-1/4 inches. Escutcheons will be cut to suit cylinders and operating trim.

#### 2.5.2 NOT USED

#### 2.5.3 Removable Mullions

Removable mullions shall be Type 22 of the box type and shall be used only with those exit devices for which the mullions were manufactured. Mullions shall be furnished with mullion stabilizers of the same manufacturer.

#### 2.5.4 NOT USED

#### 2.5.5 NOT USED

#### 2.6 NOT USED

#### 2.7 KEYING

Locks shall be keyed in sets or subsets as scheduled. Locks shall be furnished with the manufacturer's standard construction key system. Change keys for locks shall be stamped with change number and the inscription "U.S. Property - Do Not Duplicate." Keys shall be supplied as follows:

Locks:	3 change keys each lock.
Master keyed sets:	3 keys each set.
Grand master keys:	5 total.
Construction keys:	50 total.
Blank keys:	300 total.

The keys shall be furnished to the Contracting Officer arranged for key control system storage in sets or subsets as scheduled.

#### 2.8 DOOR CLOSING DEVICES

Door closing devices shall conform to BHMA ANSI/BHMA A156.4, Grade 1. Closing devices shall be products of one manufacturer for each type specified. The opening resistance of closing devices shall not exceed 15 lbf applied at the latch stile or exceed 5 lbf where low opening resistance is scheduled.

##### 2.8.1 Surface Type Closers

Surface type closers shall be Grade 1, Series C02000 Slimline Cover with options PT-4F delayed action, and PT-4D with back check position valve. Except as otherwise specified, sizes shall conform to the manufacturer's published recommendations. Closers for outswinging exterior doors shall have parallel arms or shall be top jamb mounted. Closers for doors close to a wall shall be of

narrow projection so as not to strike the wall at the 90-degree open position. Door closers shall have the following finish: 689.

2.8.2 NOT USED

2.9 NOT USED

2.10 NOT USED

2.11 NOT USED

2.12 ARCHITECTURAL DOOR TRIM

Architectural door trim shall conform to BHMA ANSI/BHMA A156.6. Finish shall be 630.

2.12.1 Door Protection Plates

2.12.1.1 NOT USED

2.12.1.2 Kick Plates

Kick plates shall be Type J102, stainless steel. Width of plates shall be 2 inches less than door width for single doors and 1 inch less for pairs of doors. Height shall be 10 inches, except where the bottom rail is less than 10 inches the plate shall extend to within 1/2 inch of the panel mold or glass bead. Edges of metal plates shall be beveled.

2.12.1.3 NOT USED

2.12.2 NOT USED

2.12.3 Push Plates

2.12.3.1 NOT USED

2.12.3.2 Flat Plates

Flat plates shall be Type J301, stainless steel, size 3" x 10". Edges of metal plates shall be beveled.

2.12.4 Door Pulls and Push/Pull Units

2.12.4.1 Arm Pulls

Arm pulls shall be Category J400, double base, stainless steel.

2.12.4.2 NOT USED

2.12.4.3 NOT USED

2.12.5 NOT USED

2.13 AUXILIARY HARDWARE

Auxiliary hardware, consisting of door stops, shall conform to BHMA ANSI/BHMA A156.16. Lever extension flush bolts shall be Type L14081. Dust-proof strikes shall be Type L04011 for doors that are not fire rated. Dust-proof strikes shall be Type L04021 for fire rated doors.

2.14 MISCELLANEOUS

#### 2.14.1 NOT USED

#### 2.14.2 Metal Thresholds

Thresholds shall conform to BHMA ANSI/BHMA A156.21. Thresholds for exterior doors shall be extruded aluminum of the type indicated and shall provide proper clearance and an effective seal with specified weather stripping. Latching thresholds shall conform to BHMA ANSI/BHMA A156.3, Type 26, and of such height that the bottom of the door shall be 1/8 inch over the tread of the threshold and 1/8 inch below the top of the stop. Where required, thresholds shall be modified to receive projecting bolts of flush bolts and exit devices. Air leakage rate of weatherstripping shall not exceed 0.5 cubic feet per minute per lineal foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

#### 2.14.3 Rain Drips

Extruded aluminum, not less than 0.07 inch thick, painted. Door sill rain drips shall be 1-1/2 inches to 1-3/4 inches high by 5/8 inch projection. Overhead rain drips shall be approximately 1-1/2 inches high by 2-1/2 inches projection and shall extend 2 inches on either side of the door opening width.

#### 2.14.4 Aluminum Housed Type Weatherseals

Weatherseals of the type indicated shall consist of extruded aluminum retainers not less than 0.07 inch wall thickness with vinyl, neoprene, silicone rubber, polyurethane or vinyl brush inserts. Aluminum shall be bronze anodized. Weatherseal material shall be of an industrial/commercial grade. Seals shall remain functional through all weather and temperature conditions. Air leakage rate of weatherstripping shall not exceed 0.5 cubic feet per minute per lineal foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

#### 2.14.5 Gasketing

Gasketing shall be a compression type seal, silicon based, self-adhesive product for use on steel door frames with steel doors for 45 minute C-label, 1-hour B-label and 1-1/2 hour B-label. Color shall be bronze. Air leakage rate of weatherstripping shall not exceed 0.5 cubic feet per minute per lineal foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

#### 2.14.6 Key Control Storage System

Key control storage system shall conform to BHMA ANSI/BHMA A156.5, Type E8331, capacity 200, and shall be properly labeled for key identification. Set up, identification labeling and location of key control storage shall be as directed at the Predelivery Conference.

### 2.15 FASTENINGS

Fastenings of proper type, size, quantity, and finish shall be supplied with each article of hardware. Machine screws and expansion shields shall be used for attaching hardware to concrete or masonry. Fastenings exposed to the weather in the finished work shall be of brass, bronze, or stainless steel.

### 2.16 FINISHES

Unless otherwise specified, finishes shall conform to those identified in ANSI/BHMA A156.18. Where painting of primed surfaces is required, painting is specified in Section C-09900 PAINTING, GENERAL.

### 2.17 HARDWARE FOR FIRE DOORS

Hardware for fire doors shall conform to the requirements of NFPA 80 and NFPA 101.

## PART 3 EXECUTION

### 3.1 APPLICATION

Hardware shall be located in accordance with DHI-04 and DHI-05, except that deadlocks shall be mounted 48 inches above finish floor. When approved, slight variations in locations or dimensions will be permitted. Mounting height of locksets at Dutch Doors shall be coordinated with stainless steel ledge. Application shall be in accordance with DHI-A115.IG or DHI A115-W. Door control devices for exterior doors such as closers and holders, shall be attached to doors with thru bolts and nuts or sex bolts. Alternate fastening methods may be approved by the Contracting Officer when manufacturers' documentation is submitted to verify that the fastening devices and door reinforcements are adequate to resist wind induced stresses.

#### 3.1.1 Hardware for Fire Doors

Hardware for fire doors shall be installed in accordance with the requirements of NFPA 80. Exit devices installed on fire doors shall have a visible label bearing the marking "Fire Exit Hardware". Other hardware installed on fire doors, such as locksets, closers, and hinges shall have a visible label or stamp indicating that the hardware items have been approved by an approved testing agency for installation on fire-rated doors.

#### 3.1.2 Door-Closing Devices

Door-closing devices shall be installed and adjusted in accordance with the templates and printed instructions supplied by the manufacturer of the devices. Insofar as practicable, doors opening to or from halls and corridors shall have the closer mounted on the room side of the door.

#### 3.1.3 Key Control Storage Systems

Key control storage system shall be installed where directed.

#### 3.1.4 Kick Plates

Kick plates shall be installed on the push side of single-acting doors.

#### 3.1.5 Auxiliary Hardware

Lever extension flush bolts shall be installed at the top and bottom of the inactive leaf of pairs of doors. The bottom bolt shall operate into a dust-proof floor strike or threshold.

#### 3.1.6 Thresholds

Thresholds shall be secured with a minimum of 3 fasteners per single door width and 6 fasteners per double door width with a maximum spacing of 12 inches. Exterior thresholds shall be installed in a bed of sealant with expansion anchors and stainless steel screws. Minimum screw size shall be No. 10 length, dependent on job conditions, with a minimum of 3/4-inch thread engagement into the floor or anchoring device used.

### 3.1.7 Rain Drips

Door sill rain drips shall align with the bottom edge of the door. Overhead rain drips shall align with bottom edge of door frame rabbet. Drips shall be set in sealant and fastened with stainless steel screws.

### 3.1.8 Weatherseals

Weatherseals shall be located as indicated, snug to door face and fastened in place with color matched metal screws after door and frames have been finish painted. Screw spacing shall be as recommended by manufacturer.

### 3.1.9 Gasketing

Gasketing shall be installed at the inside edge of the hinge and head and latch sides of door frame. Frames shall be toleranced for a 1/8 inch clearance between door and frame. Frames shall be treated with tape primer prior to installation.

## 3.2 NOT USED

## 3.3 HARDWARE SETS

### BUILDINGS B, C AND D

			<u>Bldg. B and C</u>	<u>Bldg. D</u>
HW-1	3 pr. 1 ea. 1 pr. 2 ea. 2 ea. 1 set 1 ea. 1 ea.	Hinges A5111 NRP Lockset F14 (activeleaf) Flushbolts L14081 (inactive leaf) Closers w/hold-open C02061 Kickplate Weatherstripping Threshold Astragal	101B,102,112A	102A,111
HW-2	1-1/2 pr. 1 ea. 1 ea. 1 ea. 1 set 1 ea. 1 ea.	Hinges A5111 NRP Exit Device Type 1 F08 Closer C02021 w/PT4D Kickplate Weatherstripping Raindrip Threshold J35300	103C,103D,111A	100B,100E, 101A,113A 116A
HW-3	3 pr. 2 ea. 2 ea. 1 ea. 2 ea. 2 ea.	Hinges A5111 Closers C02021 w/PT4D Exit Devices Type 1 F08 Removable Mullion Kickplates Doorstops L02251	112B	102B
HW-4	1-1/2 pr. 1 ea. 1 ea. 116B 1 ea. 1 ea.	Hinges A5111 Exit Device Type 1 F08 Closer C02021 w/PT4D Kickplate Doorstop L02251 (omit on Dr. 114)	111B,206	101B,103A, 103B,113C,
HW-5	1-1/2 pr. 1 ea. 1 ea. 1 ea. 1 ea.	Hinges A5112 Closer C02021 w/PT4D Lockset F21 Kickplate Doorstop L02251 (omit on Drs.	201,207	113B



201 Bldg. B and C)

HW-6	3 pr.	Hinges A5112	113A	
	2 ea.	Closer C02021 w/PT4D		
	1 ea.	Lockset F21 (active leaf)		
	1 pr.	Flushbolt L14081 (inactive leaf)		
	1 ea.	Dustproof Strike L04021		
	2 ea.	Kickplate		
HW-7	1-1/2 pr.	Hinges A5112	109,115,117	
	1 ea.	Lockset F10		
	1 ea.	Kickplate		
HW-8	1-1/2 pr.	Hinges A5112	108,110,	109,110
	1 ea.	Closer C02021 w/PT4F	208,209	
	1 ea.	Deadlock E0171		
	1 ea.	Push Plate J304		
	1 ea.	Arm Pull J407		
	1 ea.	Kickplate		
	1 ea.	Doorstop L02251		
HW-9	1-1/2 pr.	Hinges A5112	202,203,	105,106,107,
	1 ea.	Lockset F21	204,205	115,117,118,
	1 ea.	Kickplate	210	119
	1 ea.	Doorstop L02251		
HW-10	3 pr.	Hinges A5112	211	104
	1 ea.	Lockset F14 (active leaf)		
	1 pr.	Flushbolt L14081 (inactive leaf)		
	1 ea.	Dustproof Strike L04011		
	1 ea.	Astragal		
	2 ea.	Kickplates (door 104, Bldg.D only)		
	1 ea.	Doorstop L02251		
HW-11	1-1/2 pr.	Hinges A5112	101A	108, 112
	1 ea.	Closer C02021 w/PT4D		
	1 ea.	Lockset F14		
	1 ea.	Kickplate		
	1 ea.	Doorstop L02251 (Door 108, Bldg.D only)		

HW-12	2 pr.	Hinges A5112	106,113B,114
	1 ea.	Lockset F21	116
	1 ea.	Kickplate	
	1 ea.	Padlock F883	
	1 ea.	Hasp A83263	

HW-13	3 pr.	Hinges A5111 NRP	107
	1 ea.	Lockset F01 (active leaf)	
	1 pr.	Flushbolts L14081 (inactive leaf)	
	2 ea.	Closers w/hold-open C02061	
	2 ea.	Kickplate	
	1 set	Weatherstripping	
	1 ea.	Raindrip	
	1 ea.	Threshold	
	1 ea.	Astragal	
	1 ea.	Padlock F883	
	1 ea.	Hasp A83263	

HW-14	2 ea.	Padlock F883	
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HW-15	8 ea.	Padlock F883	
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HW-16	1 ea.	Padlock F883	
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Deployment Storage Buildings

626th FS Deployment Storage Building	101 thru 113
86th CSH Deployment Storage Building	101 thru 109

HW-16	3 pr.	Hinges A5111 NRP	
	1 ea.	Lockset F14 (active leaf)	
	1 pr.	Flushbolts L14081 (inactive leaf)	
	1 ea.	Raindrip	
	2 ea.	Kickplates	
	1 ea.	Threshold	

626th FS Sentry Building (86th CSH the same)

HW-17	1-1/2 pr.	Hinges A511 NRP	101
	1 ea.	Lockset F21	
	1 ea.	Closer C02021 w/PT4F	
	1 ea.	Kickplate	
	1 ea.	Weatherstripping	
	1 ea.	Threshold	

-- End of Section --

SECTION C-08810

GLASS AND GLAZING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1 (1984; R 1994) Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509 (1994) Elastomeric Cellular Preformed Gasket and Sealing Material

ASTM C 669 (1995) Glazing Compounds for Back Bedding and Face Glazing of Metal Sash

ASTM C 864 (1993) Dense Elastomeric Seal Gaskets, Setting Blocks, and Spacers

ASTM C 920 (1995) Elastomeric Joint Sealants

ASTM C 1036 (1991) Flat Glass

ASTM C 1172 (1996) Laminated Architectural Flat Glass

ASTM D 395 (1989; R 1994) Rubber Property - Compression Set

ASTM E 119 (1995a) Fire Tests of Building Construction and Materials

ASTM E 773 (1988) Seal Durability of Sealed Insulating Glass Units

ASTM E 774 (1992) Sealed Insulating Glass Units

ASTM E 1300 (1994) Determining the Minimum Thickness and Type of Glass Required to Resist a Specified Load

CODE OF FEDERAL REGULATIONS (CFR)

16 CFR 1201 Safety Standard for Architectural Glazing Materials

## GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA-01	(1997) Glazing Manual
GANA-04	(1995) Engineering Standards Manual

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1995) Fire Doors and Fire Windows
NFPA 252	(1995) Fire Tests of Door Assemblies
NFPA 257	(1996) Fire Tests for Window and Glass Block Assemblies

### 1.2 NOT USED

### 1.3 SYSTEM DESCRIPTION

Glazing systems shall be fabricated and installed watertight and airtight to withstand thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, and defects in the work. Glazed panels shall comply with the safety standards, as indicated in accordance with ANSI Z97.1. Glazed panels shall comply with indicated wind/snow loading in accordance with ASTM E 1300.

### 1.4 DELIVERY, STORAGE AND HANDLING

Glazing compounds shall be delivered to the site in the manufacturer's unopened containers. Glass shall be stored indoors in a safe, well ventilated dry location in accordance with manufacturer's instructions, and shall not be unpacked until needed for installation. Glass shall not be stored on site over 1 month.

### 1.5 PROJECT/SITE CONDITIONS

Glazing work shall not be started until outdoor temperature is above 40 degrees F and rising, unless procedures recommended by glass manufacturer and approved by Contracting Officer are made to warm the glass and rabbet surfaces. Ventilation shall be provided to prevent condensation of moisture on glazing work during installation. Glazing work shall not be performed during damp or raining weather.

### 1.6 WARRANTY

#### 1.6.1 Insulating Glass

Manufacturer shall warrant the insulating glass to be free of fogging or film formation on the internal glass surfaces caused by failure of the hermetic seal for a period of 10 years from Date of Substantial Completion. Warranty shall be signed by manufacturer.

## PART 2 PRODUCTS

### 2.1 FLOAT GLASS

#### 2.1.1 Annealed Glass

Annealed glass shall be Type I transparent flat type, Class 1 - clear, Quality q3 - glazing select, 90 percent light transmittance, 1.00 shading coefficient, conforming to ASTM C 1036. Color shall be clear.

2.1.2 NOT USED

2.1.3 NOT USED

2.2 ROLLED GLASS

2.2.1 NOT USED

2.2.2 Wired Glass

Wired glass shall be Type II flat type, Class 1 - translucent, Quality q8 - glazing, Form 1 - wired and polished both sides, conforming to ASTM C 1036. Wire mesh shall be polished stainless steel Mesh 1 - diamond. Wired glass for fire-rated doors shall be tested as part of a door assembly in accordance with NFPA 252. Color shall be clear.

2.3 INSULATING GLASS

Insulating glass shall be Class A preassembled units of dual-seal construction consisting of lites of glass separated by an aluminum spacer and dehydrated space conforming to ASTM E 773 and ASTM E 774. Spacer shall be roll-formed, with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone. Glass types shall be as follows:

2.3.1 Clear Insulating Glass

Glass for two-pane insulating units shall be Type I annealed glass, Class 1 - clear, Quality q3 - glazing select, conforming to ASTM C 1036. Glass performance shall be R-Value/Winter Nighttime 2.04.

2.3.2 NOT USED

2.3.3 NOT USED

2.3.4 NOT USED

2.4 NOT USED

2.5 NOT USED

2.6 LAMINATED GLAZINGS

2.6.1 Laminated Glass

Laminated glass shall consist of two layers of Type I transparent float glass, Class 1-clear Quality q3 - glazing select, conforming to ASTM C 1036. Glass shall be bonded together with 0.030 inch thick PVB plastic interlayer under pressure, or alternatives such as resin laminates, conforming to requirements of 16 CFR 1201 and ASTM C 1172. Color shall be clear.

2.7 NOT USED

2.8 NOT USED

2.9 NOT USED

2.10 NOT USED

2.11 GLAZING ACCESSORIES

#### 2.11.1 Preformed Tape

Preformed tape shall be elastomeric rubber extruded into a ribbon of a width and thickness suitable for specific application. Tape shall be of type which will remain resilient, have excellent adhesion, and be chemically compatible to glass, metal, or wood.

#### 2.11.2 Sealant

Sealant shall be elastomeric conforming to ASTM C 920, Type S or M, Grade NS, Class 12.5, Use G, of type chemically compatible with setting blocks, preformed sealing tape and sealants used in manufacturing insulating glass. Color of sealant shall be as selected.

#### 2.11.3 Glazing Gaskets

Glazing gaskets shall be extruded with continuous integral locking projection designed to engage into metal glass holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening shall be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets shall be in lengths or units recommended by manufacturer to ensure against pull-back at corners. Glazing gasket profiles shall be as indicated on drawings.

##### 2.11.3.1 Fixed Glazing Gaskets

Fixed glazing gaskets shall be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to ASTM C 509, Type 2, Option 1.

##### 2.11.3.2 Wedge Glazing Gaskets

Wedge glazing gaskets shall be high-quality extrusions of cured elastomeric virgin neoprene compounds, ozone resistant, conforming to ASTM C 864, Option 1, Shore A durometer between 65 and 75.

##### 2.11.3.3 NOT USED

#### 2.11.4 Putty and Glazing Compound

Glazing compound shall conform to ASTM C 669 for face-glazing metal sash. Putty and glazing compounds shall not be used with insulating glass or laminated glass.

#### 2.11.5 Setting and Edge Blocking

Neoprene setting blocks shall be dense extruded type conforming to ASTM D 395, Method B, Shore A durometer between 70 and 90. Edge blocking shall be Shore A durometer of 50 (+ or - 5). Silicone setting blocks shall be required when blocks are in contact with silicone sealant. Profiles, lengths and locations shall be as required and recommended in writing by glass manufacturer.

### PART 3 EXECUTION

#### 3.1 PREPARATION

Openings and framing systems scheduled to receive glass shall be examined for compliance with approved shop drawings, GANA-01 and glass manufacturer's recommendations including size, squareness, offsets at corners, presence and function of weep system, face and edge clearance requirements and effective sealing between joints of glass-framing members. Detrimental materials shall be

removed from glazing rabbet and glass surfaces and wiped dry with solvent. Glazing surfaces shall be dry and free of frost.

### 3.2 INSTALLATION

Glass and glazing work shall be performed in accordance with approved shop drawings, GANA-01, glass manufacturer's instructions and warranty requirements. Glass shall be installed with factory labels intact and removed only when instructed. Wired glass and fire/safety rated glass shall be installed in accordance with NFPA 80. Edges and corners shall not be ground, nipped or cut after leaving factory. Springing, forcing or twisting of units during installation will not be permitted.

### 3.3 CLEANING

Upon completion of project, outside surfaces of glass shall be washed clean and the inside surfaces of glass shall be washed and polished in accordance with glass manufacturer's recommendations.

### 3.4 PROTECTION

Glass work shall be protected immediately after installation. Glazed openings shall be identified with suitable warning tapes, cloth or paper flags, attached with non-staining adhesives. Glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities shall be removed and replaced with new units.

-- End of Section --

## SECTION C-08841

### TRANSLUCENT PANEL SYSTEM

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 236	(1989) Test Method for Steady State Thermal Performance of Building Assemblies.
ASTM C 297	(1988) Method for Tension Test of Flat Sandwich Constructions in Flatwise Plane.
ASTM D 635	(1988) Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.
ASTM D 1037	(1989) Method for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
ASTM D 2244	(1989) Method for Calculation of Color Differences.

##### 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-04 Drawings

Framing Materials and Accessories; FIO.

Drawings showing complete details of the proposed framing methods and materials.

##### 1.3 DELIVERY AND STORAGE

Translucent panel shall be delivered to the site in the manufacturer's unopened container. Panels shall be stored indoors on the long edge in a safe, well ventilated dry location and shall not be unpacked until needed for installation. Panel delivery scheduling shall be such as to not require on-site storage over one month.

#### PART 2 PRODUCTS

2.1 Translucent panels shall be manufactured from glass fiber reinforced thermoset resins and shall be the size as indicated on drawings. The panels shall have the following minimum performance characteristics.

2.1.1 Color stability from weathering is such that the exterior face shall not change more than 3.5 Adams Units (Delta E by ASTM D-2244), as determined by an average of three samples after at least 60 months outdoor exposure in South Florida at 7 degrees facing south.



2.1.2 Interior flamespread maximum 25 flamespread, 450 smoke, Burn Extent 1" or less by ASTM D-635.

2.1.3 Exterior face impact resistance minimum 60 ft. lbs.

2.1.4 Laminate adhesive shall be heat and pressure type engineered for structural sandwich panel use and shall pass rigorous testing requirements specified by the International Conference of Building Officials "Acceptance Criteria for Sandwich Panel Adhesive." Minimum strength shall be 700 psi tensile strength by ASTM C-297 before and after two exposures to six cycles each of the severe aging conditions prescribed by ASTM D-1037; and five prescribed exposures.

2.1.5 "U" Factor by ASTM C-236 shall be U-0.15.

2.1.6 Grid core shall be 6063-T6 aluminum beams, 7/16" flange width, mechanically interlocked to ensure even muntin-mullion intersection.

2.1.7 Exterior face shall have special erosion protective surfacing applied under factory controlled conditions during manufacture. The surfacing shall be fully field repairable and refinishable if required.

2.1.8 Panel finish shall be as indicated on the drawings.

2.1.9 Construction - all components shall be pre-assembled and sealed into panel units. They shall be shipped to the job site in rigid structural units and shall be ready for erection as units.

### 3. INSTALLATION SYSTEM:

Head, sill, jamb, and vertical closures shall have corrosion resistant finish. Closures shall maintain continuous clamping action on sealing tapes. Sealing tapes shall be factory applied to system. All screws to be stainless steel.

-- End of Section --

## SECTION C-09250

### GYPSUM WALLBOARD

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 580	(1995a) Stainless and Heat Resisting Steel Wire
ASTM A 853	(1993) Steel Wire, Carbon, for General Use
ASTM B 164	(1993) Nickel-Copper Alloy Rod, Bar, and Wire
ASTM C 36	(1995) Gypsum Wallboard
ASTM C 475	(1994) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C 514	(1996) Nails for the Application of Gypsum Board
ASTM C 645	(1995) Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board
ASTM C 754	(1996) Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board
ASTM C 840	(1996) Application and Finishing of Gypsum Board
ASTM C 1002	(1996a) Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases
ASTM C 1047	(1994) Accessories for Gypsum Wallboard and Gypsum Veneer Base

##### 1.2 NOT USED

##### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-04 Drawings

Steel Framing; FIO.

Drawings and installation details for ceiling framing, furring, special wall framing, and framed openings in walls and ceilings.

##### 1.4 QUALIFICATIONS

Manufacturer shall specialize in manufacturing the types of material specified and shall have a minimum of 10 years of documented successful experience.

Installer shall specialize in the type of gypsum board work required and shall have a minimum of 5 years of documented successful experience.

#### 1.5 DELIVERY, STORAGE AND HANDLING

Materials shall be delivered in original containers bearing the name of manufacturer, contents, and brand name. Materials shall be stored off the ground in a weathertight structure for protection. Gypsum boards shall be stacked flat, off floor and supported to prevent sagging and warpage. Adhesives and joint materials shall be stored in accordance with manufacturer's printed instructions. Damaged or deteriorated materials shall be removed from jobsite.

#### 1.6 ENVIRONMENTAL CONDITIONS

Environmental conditions for application and finishing of gypsum board shall be in accordance with ASTM C 840. During the application of gypsum board without adhesive, a room temperature of not less than 40 degrees F shall be maintained. During the application of gypsum board with adhesive, a room temperature of not less than 50 degrees F shall be maintained for 48 hours prior to application and continuously afterwards until completely dry. Building spaces shall be ventilated to remove water not required for drying joint treatment materials. Drafts shall be avoided during dry hot weather to prevent materials from drying too rapidly.

### PART 2 MATERIALS

#### 2.1 NON-LOADBEARING STUD WALLS

##### 2.1.1 Studs

Studs for non-loadbearing walls shall conform to ASTM C 645. Studs shall be C-shaped, roll formed steel, 18 gauge, punched web for utility access, made from G40 hot-dip galvanized coated sheet.

##### 2.1.2 Runner Tracks

Floor and ceiling runner tracks shall conform to ASTM C 645. Tracks shall be prefabricated, U-shaped with minimum 1 inch flanges, unpunched web, thickness to match studs, G40 hot-dip galvanized coated sheet.

#### 2.2 FOIL FACED GYPSUM WALL BOARD

Vapor retarder material shall be integral with the foil faced 5/8" gypsum wall board that is placed over the metal roof deck. The foil faced gypsum wall board shall have the joints taped. A fully compatible polyethylene tape which has equal or better water vapor control characteristics than the foil vapor retarder material shall be provided. A cloth industrial duct tape in a utility grade shall also be provided to use as needed to protect the vapor retarder from puncturing.

#### 2.3 SUSPENDED CEILING FRAMING

Carrying channels shall be formed from 16 gauge rolled steel. Furring members shall be formed from cold-rolled steel, 7/8 x 2-9/16 inch. Carrying channels and furring members shall be made from hot-dip galvanized coated sheet.

#### 2.4 GYPSUM BOARD

Gypsum board shall have square-cut ends, tapered or beveled edges and shall be maximum possible length. Gypsum board thickness shall be as shown.

##### 2.4.1 Standard Gypsum Board

Regular gypsum board shall conform to ASTM C 36, and shall be 48 inches wide.

2.4.2 NOT USED

2.4.3 NOT USED

2.4.4 NOT USED

2.4.5 NOT USED

2.4.6 NOT USED

2.4.7 NOT USED

2.4.8 NOT USED

## 2.5 TRIM, MOLDINGS, AND ACCESSORIES

### 2.5.1 Taping and Embedding Compound

Taping and embedding compound shall conform to ASTM C 475. Compound shall be specifically formulated and manufactured for use in embedding tape at gypsum wallboard joints and fastener heads, and shall be compatible with tape and substrate.

### 2.5.2 Finishing or Topping Compound

Finishing or topping compound shall conform to ASTM C 475. Compound shall be specifically formulated and manufactured for use as a finishing compound for gypsum board.

### 2.5.3 All-Purpose Compound

All-purpose compound shall be specifically formulated and manufactured to use as a taping and finishing compound, and shall be compatible with tape and substrate.

### 2.5.4 Joint Tape

Joint tape shall conform to ASTM C 475 and shall be as recommended by gypsum board manufacturer.

### 2.5.5 Trim, Control Joints, Beads, Stops and Nosings

Items used to protect edges, corners, and to provide architectural features shall be in accordance with ASTM C 1047.

## 2.6 FASTENINGS AND ADHESIVES

### 2.6.1 Nails

Nails shall conform to ASTM C 514. Nails shall be hard-drawn low or medium-low carbon steel, suitable for intended use.

### 2.6.2 Screws

Screws shall conform to ASTM C 1002. Screws shall be self-drilling and self-tapping steel, Type S for wood or light-gauge steel framing.

### 2.6.3 NOT USED

### 2.6.4 Hangers

Suspended ceiling runner channel hangers shall be soft, annealed steel wire not less than No. 8 SWG, conforming to ASTM A 853 or flat iron or steel straps, at least 3/32 by 7/8 inch size, coated with zinc, cadmium, or rust-inhibiting paint.

#### 2.6.5 Wire and Clip Type Fastenings

Tie wire, clips, rings, and other fastenings shall be corrosion-resisting steel conforming to ASTM A 580, composition 302, 304, or 316, Condition A, or nickel-copper alloy conforming to ASTM B164, annealed condition except that walls, partitions, and other vertical surfaces not incorporated in ceiling construction may be erected with soft, annealed steel conforming to ASTM A 853.

##### 2.6.5.1 Tie Wire

Tie wire for constructing partitions and vertical furring, for securing metal lath to supports, and for lacing shall be not less than No. 18 SWG. Tie wire for other applications shall be not less than No. 16 SWG.

##### 2.6.5.2 Clips

Clips used in lieu of tie wire for securing the furring channels to the runner channels in ceiling construction shall be made from strip not less than 1/8 inch thick or shall be hairpin clip, formed of wire not less than 0.01620 inch nominal diameter. Other clips and rings or fastenings of similar materials shall be equivalent in holding power to that provided by tie wire for the specific application.

### PART 3 EXECUTION

#### 3.1 INTERIOR WALL FRAMING

Steel framing and furring members shall be installed in accordance with ASTM C 754. Members shall be in alignment with spacings not to exceed the maximum spacings indicated on drawings. Runners shall be aligned accurately at the floor and ceiling and securely anchored.

##### 3.1.1 NOT USED

##### 3.1.2 NOT USED

#### 3.2 NOT USED

#### 3.3 SUSPENDED CEILING FRAMING

Suspended ceiling system framing shall be installed in accordance with ASTM C 754. There shall be no hanger wires or other loads suspended from underside of steel decking.

##### 3.3.1 Hangers

Hangers shall be spaced not more than 48 inches along runner channels and 36 inches in the other direction or 42 inches in both directions unless otherwise indicated. Locations of hanger wires shall be coordinated with other work. Hangers at ends of runner channels shall be located not more than 6 inches from wall. Hanger wire shall be looped around bottom chord of open-web steel joists, or secured to structural elements with suitable fasteners. Sags or twists which develop in the suspended system shall be adjusted. Damaged or faulty parts shall be replaced.

##### 3.3.2 Main Runners

Main runner channels shall be installed in accordance with ASTM C 754. Hanger wires shall be double strand saddle-tied to runner channels and the ends of hanger wire shall be twisted three times around itself. Main runners shall be located to within 6 inches of the paralleling wall to support the ends of cross furring. Main runners shall not come in contact with abutting masonry or concrete walls. Where main runners are spliced, ends shall be overlapped 12 inches with flanges of channels interlocked, and shall be securely tied at each end of splice with wire looped twice around the channels.

#### 3.3.3 Furring Channels

Furring channels shall be spaced in accordance with ASTM C 754. Furring channels shall be secured to the runner channels and to structural supports at each crossing with tie wire, hairpin clips, or equivalent fastenings. Furring channels shall be located within 2 inches of parallel walls and beams, and shall be cut 1/2 inch short of abutting walls.

#### 3.3.4 Ceiling Openings

Support members shall be provided as required at ceiling openings for access panels, recessed light fixtures, and air supply or exhaust. Support members shall be not less than 1-1/2 inch main runner channels and vertically installed suspension wires or straps shall be located to provide at least the minimum support specified herein for furring and wallboard attachment. Intermediate structural members not a part of the structural system, shall be provided for attachment or suspension of support members.

#### 3.3.5 Light Fixtures

Light fixtures shall not be supported directly from suspended ceiling runners. Hanger wires for recessed or surface mounted light fixtures shall be anchored to structure at four corners of light fixtures, and additional wires shall be provided at appropriate locations to carry the weight of light fixtures.

#### 3.3.6 NOT USED

### 3.4 APPLICATION OF GYPSUM BOARD

Gypsum board shall be installed in accordance with ASTM C 840 and GA 216 and as specified. Edges and ends of gypsum boards shall be cut to obtain neat fitting joints. End joints of adjoining boards shall be staggered, and shall be staggered on opposite sides of wall. Boards shall be applied with moderate contact without forcing in place. Holes for pipes, fixtures or other small openings shall be cut with a tool which will provide a neat fit. Screws shall be driven so that the heads are slightly below the plane of paper face. Fracturing the paper face or damaging the core shall be avoided. Trim shall be installed at external and internal angles formed by the intersecting gypsum board surfaces with other surfaces. Corner beads shall be installed to vertical and horizontal corners in accordance with manufacturer's published instructions.

#### 3.4.1 NOT USED

#### 3.4.2 NOT USED

#### 3.4.3 NOT USED

#### 3.4.4 NOT USED

#### 3.4.5 NOT USED

### 3.5 TRIM, MOLDINGS, AND ACCESSORIES INSTALLATION

Trim, moldings and accessories shall be installed in accordance with GA 216.

### 3.6 TAPING AND FINISHING

Gypsum board taping and finishing shall be performed in accordance with ASTM C 840. Boards shall be kept free of dirt, oil and other foreign matter that could cause a lack of bond. Screw heads, dents, gouges, and cut-outs shall be filled with joint compound and sanded. Accessories at exposed joints, edges, corners, openings, and similar locations shall be taped, floated with joint compound, and sanded to produce surfaces ready for gypsum board finishes.

### 3.7 NOT USED

### 3.8 PATCHING

Surface defects and damage shall be corrected as required to leave gypsum board smooth, uniform in appearance, and ready to receive finish as specified.

-- End of Section --

## SECTION C-09310

### CERAMIC TILE

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

#### AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.1A	(1992) Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar
ANSI A108.1B	(1992) Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar
ANSI A108.10	(1992) Installation of Grout in Tilework
ANSI A118.1	(1992) Dry-Set Portland Cement Mortar
ANSI A118.6	(1992) Ceramic Tile Grouts
ANSI A137.1	(1988) Ceramic Tile

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1994) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM C 33	(1993) Concrete Aggregates
ASTM C 144	(1993) Aggregate for Masonry Mortar
ASTM C 150	(1996) Portland Cement
ASTM C 206	(1984; R 1992) Finishing Hydrated Lime
ASTM C 207	(1991; R 1992) Hydrated Lime for Masonry Purposes
ASTM C 241	(1990) Abrasion Resistance of Stone Subjected to Foot Traffic
ASTM C 373	(1988; R 1994) Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products
ASTM C 648	(1984; R 1994) Breaking Strength of Ceramic Tile
ASTM C 847	(1995; R 1992) Metal Lath
ASTM C 1026	(1987; R 1992) Measuring Frost Resistance of Ceramic Tile to Freeze-Thaw Cycling
ASTM C 1027	(1984; R 1990) Determining Visible



## Abrasion Resistance of Glazed Ceramic Tile

ASTM C 1028

(1989) Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method

MARBLE INSTITUTE OF AMERICA (MIA)

MIA-01

(1991) Design Manual IV Dimensional Stone

TILE COUNCIL OF AMERICA (TCA)

TCA-01

(1995) Handbook for Ceramic Tile Installation

### 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

#### SD-14 Samples

Tile; GA. Accessories; GA.

Samples of sufficient size to show color range, pattern, type and joints.

### 1.3 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Materials shall be kept dry, protected from weather, and stored under cover.

### 1.4 ENVIRONMENTAL REQUIREMENTS

Ceramic tile work shall not be performed unless the substrate and ambient temperature is at least 50 degrees F and rising. Temperature shall be maintained above 50 degrees F while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used they shall be vented to the outside to avoid carbon dioxide damage to new tilework.

### 1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

## PART 2 PRODUCTS

### 2.1 TILE

Tile shall be standard grade conforming to ANSI A137.1. Containers shall be grade sealed. Seals shall be marked to correspond with the marks on the signed master grade certificate. Tile shall be impact resistant with a minimum breaking strength for wall tile of 90 lbs and 250 lbs for floor tile in accordance with ASTM C 648. Tile for cold climate projects shall be rated frost resistant by the manufacturer as determined by ASTM C 1026. Water absorption shall be 0.5 maximum percent in accordance with ASTM C 373. Floor tile shall have a minimum static coefficient of friction of 0.5 in accordance with ASTM C 1028. Tile shall be Class III as rated by the manufacturer when tested in accordance with ASTM C 1027 for abrasion resistance as related to foot traffic.

#### 2.1.1 Mosaic Tile

Ceramic mosaic tile and trim shall be unglazed porcelain with cushion edges. Tile size shall be 2 by 2 inches. Color shall be in accordance with the Color Schedule shown on the Drawings.

#### 2.1.2 NOT USED

#### 2.1.3 Glazed Wall Tile

Glazed wall tile and trim shall be cushion edged with matte glaze. Tile shall be 4-1/4 by 4-1/4 inches. Color shall be in accordance with the Color Schedule shown on the Drawings.

#### 2.1.4 Accessories

Accessories shall be the built-in type of the same materials and finish as the wall tile. Accessories shall be provided as follows: Soap dish in showers.

### 2.2 SETTING-BED

The setting-bed shall be composed of the following:

#### 2.2.1 Aggregate for Concrete Fill

Aggregate shall conform to ASTM C 33. Maximum size of coarse aggregate shall not be greater than one-half the thickness of concrete fill.

#### 2.2.2 Portland Cement

Cement shall conform to ASTM C 150, Type I, white for wall mortar and gray for other uses.

#### 2.2.3 Sand

Sand shall conform to ASTM C 144.

#### 2.2.4 Hydrated Lime

Hydrated lime shall conform to ASTM C 206, Type S or ASTM C 207, Type S.

#### 2.2.5 Metal Lath

Metal lath shall be flat expanded type conforming to ASTM C 847, and weighing not less than 2.5 pounds per square yard.

#### 2.2.6 Reinforcing Wire Fabric

Wire fabric shall conform to ASTM A 185. Wire shall be either 2 by 2 inch mesh, 16/16 wire or 1-1/2 by 2 inch mesh, 16/13 wire.

### 2.3 WATER

Water shall be potable.

### 2.4 MORTAR, GROUT, AND ADHESIVE

Mortar, grout, and adhesive shall conform to the following:

#### 2.4.1 Dry-Set Portland Cement Mortar

ANSI A118.1.

2.4.2 NOT USED

2.4.3 NOT USED

2.4.4 Ceramic Tile Grout

ANSI A118.6; sand portland cement grout, dry-set grout or commercial portland cement grout.

2.4.5 NOT USED

2.4.6 NOT USED

2.4.7 NOT USED

2.4.8 NOT USED

## 2.5 MARBLE THRESHOLDS

Marble thresholds shall be of size required by drawings or conditions. Marble shall be Group A as classified by the MIA-01. Marble shall have a fine-sand-rubbed finish and shall be white in color as approved by the Contracting Officer. Marble abrasion shall be not less than 12.0 when tested in accordance with ASTM C 241.

## PART 3 EXECUTION

### 3.1 PREPARATORY WORK AND WORKMANSHIP

Surface to receive tile shall be inspected and shall conform to the requirements of ANSI A108.1A or ANSI A108.1B for surface conditions for the type setting bed specified and for workmanship.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

Tile work shall not be started until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Floor tile installation shall not be started in spaces requiring wall tile until after wall tile has been installed. Tile in colors and patterns indicated shall be applied in the area shown on the drawings. Tile shall be installed with the respective surfaces in true even planes to the elevations and grades shown. Special shapes shall be provided as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Tile bases and coves shall be solidly backed with mortar.

### 3.3 INSTALLATION OF WALL TILE

Wall tile shall be installed in accordance with the TCA-01, method W221.

#### 3.3.1 Workable or Cured Mortar Bed

Tile shall be installed over a workable mortar bed or a cured mortar bed at the option of the Contractor. A 4 mil polyethylene membrane, metal lath, and scratch coat shall also be installed. Workable mortar bed, materials, and installation of tile shall conform to ANSI A108.1A. Cured mortar bed and materials shall conform to ANSI A108.1B.

3.3.2 NOT USED

3.3.3 NOT USED

#### 3.3.4 NOT USED

### 3.4 INSTALLATION OF FLOOR TILE

Floor tile shall be installed in accordance with TCA-01, method F111. Shower receptors shall be installed in accordance with TCA-01, method B414.

#### 3.4.1 Workable or Cured Mortar Bed

Floor tile shall be installed over a workable mortar bed or a cured mortar bed at the option of the Contractor. Workable mortar bed materials and installation shall conform to ANSI A108.1A. Cured mortar bed and materials shall conform to ANSI A108.1B.

#### 3.4.2 NOT USED

#### 3.4.3 NOT USED

#### 3.4.4 Ceramic Tile Grout

Ceramic Tile grout shall be prepared and installed in accordance with ANSI A108.10.

#### 3.4.5 NOT USED

#### 3.4.6 Concrete Fill

Concrete fill shall be composed by volume of 1 part portland cement to 3 parts fine aggregate to 4 parts coarse aggregate, and mixed with water to as dry a consistency as practicable. The fill shall be spread, tamped, and screeded to a true plane, and pitched to drains or leveled as shown. Concrete fill shall be thoroughly damp-cured before application of setting-bed material. Concrete fill shall be reinforced with one layer of reinforcement, with the uncut edges lapped the width of one mesh and the cut ends and edges lapped not less than 2 inches. Laps shall be tied together with 18 gauge wire every 10 inches along the finished edges and every 6 inches along the cut ends and edges. The reinforcement shall be supported and secured in the centers of concrete fills. The mesh shall be continuous; except where expansion joints occur, mesh shall be cut and discontinued across such joints. Reinforced concrete fill shall be provided under the setting-bed where the distance between the under-floor surface and the finished tile floor surface is 2 inches or greater, and shall be of such thickness that the mortar setting-bed to be placed over the concrete fill shall be not less than 3/4 inch nor more than 1-1/4 inches thick at any point.

#### 3.4.7 NOT USED

### 3.5 NOT USED

### 3.6 INSTALLATION OF MARBLE THRESHOLDS

Thresholds shall be installed where indicated in a manner similar to that of the ceramic tile floor. Thresholds shall be the full width of the opening. Head joints at ends shall not exceed 1/4 inch in width and shall be grouted full as specified for ceramic tile.

### 3.7 NOT USED

### 3.8 CONTROL JOINTS

Joints shall be formed as indicated and sealed as specified in Section 07920 JOINT SEALING.

### 3.8.1 Walls

Control joints shall be provided at control joints in backing material. Wherever backing material changes, a control joint shall be formed to separate the different materials.

### 3.8.2 Floors

Control joints shall be provided over construction joints, control joints, and expansion joints in concrete slabs. Expansion joints shall extend through setting-beds and fill.

## 3.9 CLEANING AND PROTECTING

Upon completion, tile surfaces shall be thoroughly cleaned in accordance with manufacturer's approved cleaning instructions. Acid shall not be used for cleaning glazed tile. Floor tile with resinous grout or with factory mixed grout shall be cleaned in accordance with instructions of the grout manufacturer. After the grout has set, tile wall surfaces shall be given a protective coat of a noncorrosive soap or other approved method of protection. Tiled floor areas shall be covered with building paper before foot traffic is permitted over the finished tile floors. Board walkways shall be laid on tiled floors that are to be continuously used as passageways by workmen. Damaged or defective tiles shall be replaced.

-- End of Section --

## SECTION C-09510

### ACOUSTICAL CEILINGS

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 635	(1995) Manufacture performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C 636	(1992) Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM E 119	(1995a) Fire Tests of Building Construction and Materials
ASTM E 1264	(1990) Standard Classification for Acoustical Ceiling Products
ASTM E1414	(1991a) Standard Test for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.

##### 1.2 GENERAL REQUIREMENTS

Acoustical treatment shall consist of sound controlling units mechanically mounted on a suspended ceiling system. The unit size, texture, finish, and color shall be as specified. The location and extent of acoustical treatment shall be as shown on the drawings.

##### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-04 Drawings

Acoustical Ceiling System; FIO.

Drawings shall show suspension system, method of anchoring and fastening, and reflected ceiling plan.

##### SD-14 Samples

Acoustical Units; FIO.

Two samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color.

##### 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Materials shall be carefully handled and stored in dry, watertight enclosures. Immediately before installation, acoustical units shall be stored for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

#### 1.5 ENVIRONMENTAL REQUIREMENTS

A uniform temperature of not less than 60 degrees F nor more than 85 degrees F and a relative humidity of not more than 70 percent shall be maintained before, during, and after installation of acoustical units.

#### 1.6 SCHEDULING

Interior finish work such as plastering, concrete and terrazzo work shall be complete and dry before installation. Mechanical, electrical, and other work above the ceiling line shall be completed and heating, ventilating, and air conditioning systems shall be installed and operating in order to maintain temperature and humidity requirements.

#### 1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

#### 1.8 EXTRA MATERIALS

Spare tiles of each color shall be furnished at the rate of 5 tiles for each 1000 tiles installed. Tiles shall be from the same lot as those installed.

### PART 2 PRODUCTS

#### 2.1 ACOUSTICAL UNITS

Acoustical units shall conform to ASTM E 1264, Class A, and the following requirements:

##### 2.1.1 Units for Exposed-Grid System

Type: IV.  
NRC grade: 55 minimum when tested on mounting No. E-400.  
Pattern: D.  
Nominal size: 24 x 48 inches.  
Edge detail: Trimmed and butt.  
Finish: Factory-applied white finish.  
Minimum LR Coefficient: 0.70  
Minimum CAC: 40

##### 2.1.2 NOT USED

##### 2.1.3 NOT USED

#### 2.2 SUSPENSION SYSTEM

Suspension system shall be exposed-grid as shown on drawings, and shall conform to ASTM C 635 for intermediate-duty systems. Surfaces exposed to view shall be aluminum or steel with a factory-applied white baked-enamel finish. Wall molding shall have a flange of not less than 15/16 inch. Inside and outside corner caps shall be provided.

#### 2.3 HANGERS

Hangers shall be galvanized steel wire. Hangers and attachment shall support a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.

## 2.4 ACCESS PANELS

Access panels shall match adjacent acoustical units and shall be designed and equipped with suitable framing and fastenings for removal and replacement without damage. Panel shall be not less than 12 by 12 inches or more than 12 by 24 inches. An identification plate of 0.032-inch thick aluminum, 3/4 inch in diameter, stamped with the letters "AP" and finished the same as the unit, shall be attached near one corner on the face of each access panel.

## 2.5 NOT USED

## 2.6 FINISHES

Acoustical units and suspension system members shall have manufacturer's standard textures, patterns and finishes as specified. Ceiling suspension system components shall be treated to inhibit corrosion.

## 2.7 COLORS AND PATTERNS

Colors and patterns for acoustical units and suspension system components shall be as shown.

## 2.8 CEILING ATTENUATION CLASS AND TEST

Ceiling attenuation class (CAC) range of acoustical units, when required, shall be determined in accordance with ASTM E 1414. Test ceiling shall be continuous at the partition and shall be assembled in the suspension system in the same manner that the ceiling will be installed on the project. System shall be tested with all acoustical units installed.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Acoustical work shall be provided complete with all necessary fastenings, clips, and other accessories required for a complete installation. Mechanical fastenings shall not be exposed in the finished work. Hangers shall be laid out for each individual room or space. Hangers shall be placed to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Main runners and carrying channels shall be kept clear of abutting walls and partitions. At least two main runners shall be provided for each ceiling span. Wherever required to bypass an object with the hanger wires, a subsuspension system shall be installed, so that all hanger wires will be plumb.

### 3.1.1 Suspension System

Suspension system shall be installed in accordance with ASTM C 636 and as specified herein. There shall be no hanger wires or other loads suspended from underside of steel decking.

#### 3.1.1.1 Plumb Hangers

Hangers shall be plumb and shall not press against insulation covering ducts and pipes.

#### 3.1.1.2 Splayed Hangers



Where hangers must be splayed (sloped or slanted) around obstructions, the resulting horizontal force shall be offset by bracing, countersplaying, or other acceptable means.

#### 3.1.2 Wall Molding

Wall molding shall be provided where ceilings abut vertical surfaces. Wall molding shall be secured not more than 3 inches from ends of each length and not more than 16 inches on centers between end fastenings.

#### 3.1.3 Acoustical Units

Acoustical units shall be installed in accordance with the approved installation instructions of the manufacturer. Edges of acoustical units shall be in close contact with metal supports, with each other, and in true alignment. Acoustical units shall be arranged so that units less than one-half width are minimized. Units in exposed-grid system shall be held in place with manufacturer's standard hold-down clips, if units weigh less than 1 psf.

#### 3.2 CEILING ACCESS PANELS

Ceiling access panels shall be located directly under the items to which access is required.

#### 3.3 CLEANING

Following installation, dirty or discolored surfaces of acoustical units shall be cleaned and left free from defects. Units that are damaged or improperly installed shall be removed and new units provided as directed.

-- End of Section --

## SECTION C-09650

### RESILIENT FLOORING

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2240	(1997) Rubber Property - Durometer Hardness
ASTM D 4078	(1992; R 1996) Water Emulsion Floor Polish
ASTM E 648	(1997) Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM E 662	(1994a) Specific Optical Density of Smoke Generated by Solid Materials
ASTM F 1066	(1995a) Vinyl Composition Floor Tile

##### 1.2 NOT USED

##### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-01 Data

Resilient Flooring and Accessories; FIO.

Manufacturer's descriptive data and installation instructions. Cleaning and maintenance instructions shall be included.

##### SD-14 Samples

Resilient Flooring and Accessories; GA.

Three samples of each indicated color and type of flooring and base. Sample size shall be minimum 3 inches by 5 inches.

##### 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the building site in original unopened containers bearing the manufacturer's name, project identification and handling instructions. Materials shall be stored in a clean dry area with temperature maintained above 70 degrees F for 2 days prior to installation, and shall be stacked according to manufacturer's recommendations. Materials shall be protected from the direct flow of heat from hot air registers, radiators and other heating fixtures and appliances.

##### 1.5 ENVIRONMENTAL REQUIREMENTS

Areas to receive resilient flooring shall be maintained at a temperature above 70 degrees F for 2 days before application, during application and 2 days after

application. A minimum temperature of 55 degrees F shall be maintained thereafter.

#### 1.6 SCHEDULING

Resilient flooring application shall be scheduled after the completion of other work which would damage the finished surface of the flooring.

#### 1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

#### 1.8 EXTRA MATERIALS

Extra flooring material of each color and pattern shall be furnished at the rate of 5 tiles for each 1000 tiles installed. Extra materials shall be from the same lot as those installed. Extra base material composed of 20 linear feet of each color shall be furnished.

### PART 2 PRODUCTS

#### 2.1 VINYL-COMPOSITION TILE

Vinyl-composition tile shall conform to ASTM F 1066, Class 2, through pattern tile, Composition 1, asbestos-free, and shall be 12 inches square and 1/8 inch thick. Tile shall have the color and pattern uniformly distributed throughout the thickness of the tile. Flooring in any one continuous area shall be from the same lot and shall have the same shade and pattern.

#### 2.2 NOT USED

#### 2.3 NOT USED

#### 2.4 NOT USED

#### 2.5 NOT USED

#### 2.6 RESILIENT BASE

Base shall be manufacturers standard coved style (installed with resilient flooring). Base shall be 4 inches high and a minimum 1/8 inch thick. Preformed outside corners shall be furnished.

#### 2.7 NOT USED

#### 2.8 FEATURE STRIP

Feature strips shall be vinyl 1 inch wide, and of thickness to match the flooring. Color shall be as indicated.

#### 2.9 NOT USED

#### 2.10 ADHESIVE

Adhesive for flooring and wall base shall be as recommended by the flooring manufacturer.

#### 2.11 POLISH

Polish shall conform to ASTM D 4078.

## 2.12 CAULKING AND SEALANTS

Caulking and sealants shall be in accordance with Section C-07920 JOINT SEALING.

## 2.13 MANUFACTURER'S COLOR AND TEXTURE

Color and texture shall be as shown.

## PART 3 EXECUTION

### 3.1 EXAMINATION/VERIFICATION OF CONDITIONS

The Contractor shall examine and verify that site conditions are in agreement with the design package and shall report all conditions that will prevent a proper installation. The Contractor shall not take any corrective action without written permission from the Government.

### 3.2 SURFACE PREPARATION

Flooring shall be in a true, level plane, except where indicated as sloped. Before any work under this section is begun, all defects such as rough or scaling concrete, low spots, high spots, and uneven surfaces shall have been corrected, and all damaged portions of concrete slabs shall have been repaired as recommended by the flooring manufacturer. Concrete curing compounds, other than the type that does not adversely affect adhesion, shall be entirely removed from the slabs. Paint varnish, oil, release agents, sealers waxers, and adhesives shall be removed, as recommended by the flooring manufacturer.

### 3.3 MOISTURE TEST

The suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content shall be determined by a moisture test as recommended by the flooring manufacturer.

### 3.4 INSTALLATION OF VINYL-COMPOSITION TILE

Tile flooring shall be installed with adhesive in accordance with the manufacturer's installation instructions. Tile lines and joints shall be kept square, symmetrical, tight, and even. Edge width shall vary as necessary to maintain full-size tiles in the field, but no edge tile shall be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Flooring shall be cut to, and fitted around, all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Edge tile shall be cut, fitted, and scribed to walls and partitions after field flooring has been applied.

### 3.5 NOT USED

### 3.6 NOT USED

### 3.7 INSTALLATION OF FEATURE STRIPS

Edge strips shall be secured with adhesive as recommended by the manufacturer. Edge strips shall be provided at locations where flooring termination is higher than the adjacent finished flooring, except at doorways where thresholds are provided.

### 3.8 INSTALLATION OF RESILIENT BASE

Wall base shall be installed with adhesive in accordance with the manufacturer's written instructions. Base joints shall be tight and base shall be even with adjacent resilient flooring. Voids along the top edge of base at masonry walls shall be filled with caulk.

3.9 NOT USED

3.10 NOT USED

3.11 CLEANING

Immediately upon completion of installation of tile in a room or an area, flooring and adjacent surfaces shall be cleaned to remove all surplus adhesive. After installation, flooring shall be washed with a cleaning solution, rinsed thoroughly with clear cold water, and given two coats of polish in accordance with manufacturers written instructions. After each polish coat, floors shall be buffed to an even luster with an electric polishing machine.

3.12 PROTECTION

From the time of laying until acceptance, flooring shall be protected from damage as recommended by the flooring manufacturer. Flooring which becomes damaged, loose, broken, or curled shall be removed and replaced.

-- End of Section --

## SECTION C-09900

### PAINTING, GENERAL

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3273	(1994) Resistance to Growth of Mold on the Surface of Interior Coating in an Environmental Chamber
ASTM D 3274	(1995) Evaluating Degree of Surface Disfigurement of Paint Films by Microbial (Fungal or Algal) Growth or Soil and Dirt Accumulation
ASTM D 4214	(1989) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4258	(1988; R 1992) Surface Cleaning Concrete for Coating

##### COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1500	(Rev A) Sealer, Surface (Latex Block Filler)
CID A-A-2246	(Rev A) Paint, Latex (Gloss, Interior)
CID A-A-2247	(Basic) Paint, Latex (Semigloss, Interior)
CID A-A-2248	(Basic) Paint, Latex, (Flat, Interior)
CID A-A-2867	(Basic) Coating, Polyurethane, Single Component Moisture Cure, Aliphatic
CID A-A-2962	(Basic) Enamel, Alkyd
CID A-A-2994	(Basic) Primer Coating, Interior, for Walls and Wood

##### FEDERAL SPECIFICATIONS (FS)

FS TT-E-2784	(Rev A) Enamel (Acrylic-Emulsion, Exterior Gloss and Semigloss) (Metric)
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##### STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 5	(1995) Zinc Dust, Zinc Oxide and Phenolic Varnish Paint
SSPC Paint 20	(1991) Zinc-Rich Primers (Type I - Inorganic and Type II - Organic)
SSPC Paint 23	(1982) Latex Primer for Steel surfaces
SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)
SSPC SP 1	(1982) Solvent Cleaning



manufacturer. Moisture-curing polyurethane shall not be applied when the relative humidity is below 30 percent.

## 1.6 SAFETY AND HEALTH

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in the CONTRACT CLAUSES. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

### 1.6.1 Worker Exposures

Exposure of workers to chemical substances shall not exceed limits established by ACGIH-02, or as required by a more stringent applicable regulation.

### 1.6.2 Toxic Compounds

Toxic compounds having ineffective physiological properties, such as no or low odor or irritation levels, shall not be used unless approved by the Contracting Officer.

### 1.6.3 Training

Workers having access to an affected work area shall be informed of the contents of the applicable material data safety sheets (MSDS) and shall be informed of potential health and safety hazard and protective controls associated with materials used on the project. An affected work area is one which may receive mists and odors from the painting operations. Workers involved in preparation, painting and clean-up shall be trained in the safe handling and application, and the exposure limit, for each material which the worker will use in the project. Personnel having a need to use respirators and masks shall be instructed in the use and maintenance of such equipment.

### 1.6.4 Coordination

Work shall be coordinated to minimize exposure of building occupants, other Contractor personnel, and visitors to mists and odors from preparation, painting and clean-up operations.

## PART 2 PRODUCTS

### 2.1 PAINT

The term "paint" as used herein includes emulsions, enamels, paints, stains, varnishes, sealers, cement-emulsion filler, and other coatings, whether used as prime, intermediate, or finish coat. Paint shall conform to the requirements listed in the painting schedules at the end of this section, except when the required amount of a material of a particular batch is 50 gallons or less, an approved first-line proprietary paint material with similar intended usage and color to that specified may be used. Additional requirements are as follows:

#### 2.1.1 Colors and Tints

Colors shall be as shown on the drawings. Tinting of epoxy and urethane, paints shall be done by the manufacturer. Stains shall conform in shade to manufacturer's standard color. The color of the undercoats shall vary slightly from the color of the next coat.

#### 2.1.2 Mildewcide and Insecticide



Paint specified for all coats applied to fabrics and vapor barrier jackets over insulation shall contain a mildewcide that will not adversely affect the color, texture, or durability of the coating. The mildewcide shall be incorporated into the paint by the manufacturer and shall attain a surface disfigurement rating of 8 or greater when tested in accordance with ASTM D 3273 and evaluated in accordance with ASTM D 3274. Mercurial mildewcide shall not be used in interior paint. Insecticides shall not be used in paint.

#### 2.1.3 Lead

Paints containing lead in excess of 0.06 percent by weight of the total nonvolatile content (calculated as lead metal) shall not be used.

#### 2.1.4 Chromium

Paints containing zinc chromate or strontium chromate pigments shall not be used.

#### 2.1.5 Volatile Organic Compound (VOC) Content

Paints shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards and shall conform to the restrictions of the local air pollution control authority.

### PART 3 EXECUTION

#### 3.1 PROTECTION OF AREAS NOT TO BE PAINTED

Items not to be painted which are in contact with or adjacent to painted surfaces shall be removed or protected prior to surface preparation and painting operations. Items removed prior to painting shall be replaced when painting is completed. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Surfaces contaminated by coating materials shall be restored to original condition.

#### 3.2 SURFACE PREPARATION

Surfaces to be painted shall be clean and free of foreign matter before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

##### 3.2.1 Concrete, Stucco and Masonry Surfaces

Concrete, stucco and masonry surfaces shall be allowed to dry at least 30 days before painting, except concrete slab on grade which shall be allowed to cure 90 days before painting. Surfaces shall be cleaned in accordance with ASTM D4258. Glaze, efflorescence, laitance, dirt, grease, oil, asphalt, surface deposits of free iron and other foreign matter shall be removed prior to painting. Surfaces to receive polyurethane or epoxy coatings shall be acid-etched or mechanically abraded as specified by the coating manufacturer, rinsed with water, allowed to dry, and treated with the manufacturer's recommended conditioner prior to application of the first coat.

##### 3.2.2 Ferrous Surfaces

Ferrous surfaces including those that have been shop-coated, shall be solvent-cleaned or detergent-washed in accordance with SSPC SP1. Surfaces that contain loose rust, loose mill scale, and other foreign substances shall be cleaned

mechanically with hand tools according to SSPC SP 2, power tools according to SSPC SP 3 or by sandblasting according to SSPC SP 7. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

### 3.2.3 Nonferrous Metallic Surfaces

Galvanized, aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces shall be solvent-cleaned in accordance with SSPC SP 1.

### 3.2.4 Gypsum Board Surfaces

Gypsum board surfaces shall be dry and shall have all loose dirt and dust removed by brushing with a soft brush, rubbing with a cloth, or vacuum-cleaning prior to application of the first-coat material. A damp cloth or sponge may be used if paint will be water-based.

### 3.2.5 Mastic-Type Surfaces

Mastic-type surfaces shall be prepared by removing foreign material.

### 3.2.6 NOT USED

### 3.2.7 Wood Surfaces

Wood surfaces shall be cleaned of foreign matter. Moisture content of the wood shall not exceed 12 percent as measured by a moisture meter, unless otherwise authorized. Wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched up before applying water-thinned paints. Small, dry seasoned knots shall be scraped, cleaned, and given a thin coat of commercial knot sealer, before application of the priming coat. Pitch on large, open, unseasoned knots and all other beads or streaks of pitch shall be scraped off, or, if it is still soft, removed with mineral spirits or turpentine, and the resinous area shall be thinly coated with knot sealer. Finishing nails shall be set, and all holes and surface imperfections shall be primed. After priming, holes and imperfections in finish surfaces shall be filled with putty or plastic wood filler, colored to match the finish coat if natural finish is required, allowed to dry, and sanded smooth. Putty or wood filler shall be compatible with subsequent coatings.

#### 3.2.7.1 Interior Wood Stain

Interior wood surfaces to receive stain shall be sanded. Oak and other open-grain wood to receive stain shall be given a coat of wood filler not less than 8 hours before the application of stain; excess filler shall be removed and the surface sanded smooth.

### 3.2.8 Previously Painted Surfaces

Previously painted surfaces damaged during construction shall be thoroughly cleaned of all grease, dirt, dust or other foreign matter. Blistering, cracking, flaking and peeling or other deteriorated coatings shall be removed. Slick surfaces shall be roughened. Damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls shall be repaired with suitable material to match adjacent undamaged areas. Edges of chipped paint shall be feather edged and sanded smooth. Rusty metal surfaces shall be cleaned as per SSPC requirements. Solvent, mechanical, or chemical cleaning methods shall be used to provide surfaces suitable for painting. Chalk shall be removed so that when tested in accordance with ASTM D 4214, the chalk resistance rating is no less than 8. New, proposed coatings shall be compatible with existing coatings. If existing surfaces are glossy, the gloss shall be reduced.

### 3.3 MIXING AND THINNING

When thinning is approved as necessary to suit surface, temperature, weather conditions, or application methods, paints may be thinned in accordance with the manufacturer's directions. When thinning is allowed, paints shall be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed local limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

#### 3.3.1 Cement-Emulsion Filler Coat

Cement and aggregate shall be dry-mixed so that uniform distribution and intermixing are obtained. Mixing liquid and one-half of the total amount of water shall be premixed and added gradually to the white portland cement and aggregate with constant stirring until a thick, smooth material is obtained. Emulsion paint shall then be added to the mixture and stirred until uniformity is obtained. The blend shall have a thick, creamy consistency. The remainder of the water shall be added if necessary to obtain a material with adequate application properties. Blending resin emulsion or emulsion paint with any other component shall be done with caution; too rapid an agitation will cause air entrapment and foaming.

#### 3.3.2 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

### 3.4 APPLICATION

Painting practices shall comply with applicable state and local laws enacted to insure compliance with Federal Clean Air Standards. Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application. Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces. Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

#### 3.4.1 Ventilation

Affected areas shall be ventilated during paint application so that workers exposure to chemical substances shall not exceed limits as established by ACGIH-02, or as required by a more stringent applicable regulation. Interior work zones having a volume of 10,000 cubic feet or less shall be ventilated at a minimum of 2 air exchanges per hour. Ventilation in larger work zones shall be maintained by means of mechanical exhaust. Solvent vapors shall be exhausted outdoors, away from air intakes and workers. Return air inlets in the work zone shall be temporarily sealed before start of work until the coatings have dried.

#### 3.4.2 Respirators

Operators and personnel in the vicinity of operating paint sprayers shall wear respirators.

#### 3.4.3 First Coat

The first coat on gypsum wallboard, and other surfaces shall include repeated touching up of suction spots or overall application of primer or sealer to produce uniform color and gloss. Excess sealer shall be wiped off after each application. Glazed doors and sashes shall be given the specified coating system within 3 weeks of the time they are glazed, but not before the glazing material has set; paint shall overlay glass about 70 mils all around. Each varnish coat shall be sanded lightly prior to application of subsequent coats.

#### 3.4.4 Timing

Surfaces that have been cleaned, pretreated, and otherwise prepared for painting shall be given a coat of the specified first coat as soon as practical after such pretreatment has been completed, but prior to any deterioration of the prepared surface. Sufficient time shall elapse between successive coats to permit proper drying. This period shall be modified as necessary to suit weather conditions. Oil-based or oleoresinous solvent-type paints shall be considered dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and the application of another coat of paint does not cause the undercoat to lift or lose adhesion. Manufacturer's instructions for application, curing and drying time between coats of two-component systems shall be followed.

#### 3.4.5 Stains

Stain shall be applied at the rate specified in the manufacturer's printed directions. Oil-type stain shall be applied by brushing with the grain for the full length of the board.

#### 3.4.6 Fillers

Concrete and masonry surface voids shall be filled; however, surface irregularities need not be completely filled. The dried filler shall be uniform and free of pinholes. Filler shall not be applied over caulking compound.

##### 3.4.6.1 Cement-Emulsion Filler

Immediately before filler application, surfaces shall be dampened uniformly and thoroughly, with no free surface water visible, by several applications of potable water with a fog spray, allowing time between the sprayings for water to be absorbed. Cement-emulsion filler shall be scrubbed into the surface vigorously with a stiff-bristled brush having tampico or palmyra bristles not longer than 2-1/2 inches. At least 24 hours shall elapse before applying exterior emulsion paint over cement-emulsion filler. When the ambient temperature is over 85 degrees F, cement-emulsion filler surfaces shall be dampened lightly with a fog spray of potable water immediately prior to application of the subsequent paint coat.

##### 3.4.6.2 Latex Filler

Latex filler, CID A-A-1500, shall be applied according to the manufacturer's instructions. Surface voids shall be filled and excess filler shall be removed from the surface with a rubber squeegee. The filler shall be allowed to dry the length of time specified by the manufacturer prior to applying successive coats of paint.

### 3.4.7 NOT USED

### 3.4.8 Ferrous-Metal Primer

Primer for ferrous-metal shall be applied to ferrous surfaces to receive paint other than asphalt varnish prior to deterioration of the prepared surface. The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

## 3.5 PIPE COLOR CODE MARKING

Pipes in exposed areas and in accessible pipe spaces shall be provided with color band and titles adjacent to all valves, except those provided at plumbing fixtures, at not more than 40 foot spacing on straight pipe runs, adjacent to change in direction, and on both sides where pipes pass through walls or floors. Color code marking shall be of the color listed in TABLE I and the size listed in TABLE II. The arrows shall be installed adjacent to each band to indicate the direction of flow in the pipe. The legends shall be printed in upper-case black letters as listed in TABLE I. Letter sizes shall be as listed in TABLE II. Marking shall be painted or applied using colored, pressure-sensitive adhesive markers of standard manufacture. Paint shall be as specified for insulated and uninsulated piping.

TABLE I. COLOR CODES FOR MARKING PIPE

Material	Band	Letters and Arrow*	Legend
Cold water (potable)	Green	White	POTABLE
Fire protection water	Red	White	FIRE PR.
Hot water (domestic)	Green	White	H.W.
Hot water recirculating (domestic)	Green	White	H.W.R.
High temp. water supply	Yellow	Black	H.T.W.S.
High temp. water return	Yellow	Black	H.T.W.R.
Boiler feed water	Yellow	Black	B.F.
Low temp. water supply (heating)	Yellow	Black	L.T.W.S.
Low temp. water return (heating)	Yellow	Black	L.T.W.R.
Condenser water supply	Green	White	COND. W.S.
Condenser water return	Green	White	COND. W.R.
Chilled water supply	Green	White	C.H.W.S.
Chilled water return	Green	White	C.H.W.R.
Treated water	Yellow	Black	TR. WATER
Chemical feed	Yellow	Black	CH. FEED
Compressed air	Yellow	Black	COMP. AIR
Natural gas	Blue	White	NAT. GAS
Freon	Blue	White	FREON
Fuel oil	Yellow	Black	FUEL OIL
Steam	Yellow	Black	STM.
Condensate	Yellow	Black	COND.

TABLE II. COLOR CODE MARKING SIZES

Outside Diameter of Pipe Covering (Inches)	Length of Color Band (inches)	Arrow Length x Width (Inches)	Size of Legend Letters and Numerals (Inches)
Less than 1-1/2	8	8 x 2-1/4	1/2
1-1/2 to 2-3/8	8	8 x 2-1/4	3/4
2-1/2 to 7-7/8	12	8 x 2-1/4	1-1/4
8 to 10	24	12 x 4-1/2	2-1/2

$$3-1/2$$

### 3.7 SURFACES TO BE PAINTED

### 3.8 SURFACES NOT TO BE PAINTED

Walls and ceilings in concealed spaces.  
Unexposed interior ferrous surfaces.  
Aluminum or sized vapor barrier jacketing over insulation pipes, in unexposed locations that do not require color coding.  
Fire protection equipment.  
Prefinished ceilings and floor coverings.

### 3.9 CLEANING

### 3.10 PAINTING SCHEDULES

## EXTERIOR PAINTING SCHEDULE

Surface	First Coat	Second Coat	Third Coat
Concrete, unless otherwise specified.	FS TT-E-2784 Type III	FS TT-E-2784 Type III	None
Wood, unless otherwise specified.	FS TT-E-2784 Type III	FS TT-E-2784 Type III	FS TT-E-2784 Type III
Ferrous metal unless otherwise specified	SSPC Paint 23	FS TT-E-2784 Type I	FS TT-E-2784 Type 1
Galvanized metal.	FS TT-E-2784 Type III	FS TT-E-2784 Type III	FS TT-E-2784 Type III
Aluminum aluminum-alloy,	FS TT-E-2784 Type III	FS TT-E-2784 Type I	FS TT-E-2784 Type I

and other non-ferrous metal (non-galvanized)

# INTERIOR PAINTING SCHEDULE

Surface	First Coat	Second Coat	Third Coat
Gypsum board, concrete, and concrete masonry units not requiring a smooth finish, unless otherwise specified.	CID A-A-2994 Type II	CID A-A-2246	None
		-----or-----	
		CID A-A-2247	None
		-----or-----	
		CID A-A-2248	None
Concrete masonry units requiring a smooth finish	CID A-A-1500	CID A-A-2994 Type II	CID A-A-2246
			-----or-----
			CID A-A-2247
			-----or-----
			CID A-A-2248
Ferrous Metal unless otherwise specified	SSPC Paint 25	CID A-A-2962 Type I	CID A-A-2962 Type I
Aluminum and aluminum alloy unless otherwise specified.	FS TT-E-2784 Type III	FS TT-E-2784 Type I	FS TT-E-2784 Type I
Ferrous metal factory-primed mechanical and electrical equipment.	Two coats of paint as recommended by the equipment manufacturer		None
Galvanized metal:	SSPC Paint 5	CID A-A-2962 Type I	CID A-A-2962 Type I
Wood: unless otherwise specified.	CID A-A-2994 Type I	CID A-A-2246	None
		-----or-----	
		CID A-A-2247	None
		-----or-----	
		CID A-A-2248	None
Wood: stain and varnish finishes.	Commercially available stain	CID A-A-1788	CID A-A-1788
		In addition a fourth coat of CID A-A-1788	
		CID A-A-2339	CID A-A-2834
		CID A-A-2834	CID A-A-2834

Type I

Type I

In addition a fourth coat of  
CID A-A-2834

Type I



Ferrous Metal:			
Convector	SSPC Paint 23	None	None
enclosures,			
electrical			
conduit runs:			
metallic tubing			
uninsulated			
ducts and pipes,			
pipe hangers,			
louvers, grilles,			
and air outlets,			
in areas having			
painted adjacent			
surfaces.			
Aluminum and Galvanized Surface Metal:			
Convector	FS TT-E-2784	CID A-A-2246	CID A-A-2246
enclosures,		-----or-----	
electrical		CID A-A-2247	CID A-A-2247
conduit runs		-----or-----	
metallic tubing		CID A-A-2248	CID A-A-2248
uninsulated			
ducts and pipes,			
pipe hangers,			
louvers, grilles,			
and air outlets,			
in areas having			
painted adjacent			
surfaces.			
Facing of vapor	Two coats of paint		None
barrier jackets	to match		
of presized or	adjacent areas		
adhesive			
finished cloth			
cover insulation			
on pipes, ducts,			
and equipment in			
following area.			
Exposed to view			
interior locations.			

--End of Section--

## SECTION C-10160

### TOILET PARTITIONS

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### FEDERAL SPECIFICATIONS (FS)

FS RR-P-1352 (Rev C) Partitions, Toilet, Complete

##### 1.2 SYSTEM DESCRIPTION

Toilet partition system, including toilet enclosures, partition-type doors at shower entrances, and urinal screens, shall be a complete and usable system of panels, hardware, and support components. The partition system shall be provided by a single manufacturer and shall be a standard product as shown in the most recent catalog data. The partition system shall be as shown.

##### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01300 SUBMITTAL DESCRIPTIONS:

###### SD-01 Data

Toilet Partition System; FIO.

Manufacturer's technical data and catalog cuts including installation and cleaning instructions.

###### SD-04 Drawings

Toilet Partition System; FIO.

Drawings showing plans, elevations, details of construction, hardware, reinforcing, fittings, mountings, and anchorings.

###### SD-14 Samples

Toilet Partition System; FIO.

Manufacturer's standard color charts and color samples.

##### 1.4 DELIVERY, STORAGE, AND HANDLING

Components shall be delivered to the jobsite in the manufacturer's original packaging with the brand, item identification, and project reference clearly marked. Components shall be stored in a dry location that is adequately ventilated and free from dust, water, or other contaminants and shall have easy access for inspection and handling.

##### 1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

## PART 2 PRODUCTS

### 2.1 TOILET ENCLOSURES

Toilet enclosures shall conform to FS RR-P-1352, Type I, Style A. Width, length and height of toilet enclosures shall be as shown. Finish surface of panels shall be stainless steel 3. Panels indicated to receive toilet paper holders as specified in Section C-10800 TOILET ACCESSORIES shall be reinforced for the reception of the items required.

### 2.2 PARTITION TYPE DOORS AT SHOWER ENTRANCES

Partition-type doors at shower entrances shall conform to FS RR-P-1352. Finish surface of doors shall be stainless steel 3. Door and supporting members shall be as shown.

### 2.3 URINAL SCREENS

Urinal screens shall conform to FS RR-P-1352, Type III, Style D. Finish surface of screens shall be stainless steel 3. Width and height of urinal screens shall be as shown.

### 2.4 HARDWARE

Hardware for the toilet partition system shall conform to FS RR-P-1352 for the specified type and style of partitions and doors. Hardware finish shall be highly resistant to alkalies, urine, and other common toilet room acids.

### 2.5 NOT USED

## PART 3 EXECUTION

### 3.1 INSTALLATION

Toilet partitions shall be installed straight and plumb in accordance with approved manufacturer's instructions with horizontal lines level and rigidly anchored to the supporting construction. Where indicated, anchorage to walls shall be by toggle-bolting. Drilling and cutting for installation of anchors shall be at locations that will be concealed in the finished work.

### 3.2 ADJUSTING AND CLEANING

Doors shall have a uniform vertical edge clearance of approximately 3/16 inch and shall rest open at approximately 30 degrees when unlatched. Toilet partitions shall be cleaned in accordance with approved manufacturer's instructions and shall be protected from damage until accepted.

-- End of Section --

SECTION C-10430

EXTERIOR SIGNAGE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1 (1984; Rev 1994) Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36 (1996) Carbon Structural Steel

ASTM A 123 (1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 570 (1996) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality

ASTM A 653 (1996) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 653M (1995) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process (Metric)

ASTM A 924 (1996) Steel Sheet, Metallic-Coated by the Hot-Dip Process

ASTM A 924M (1995) Steel Sheet, Metallic-Coated by the Hot-Dip Process (Metric)

ASTM B 26 (1996) Aluminum-Alloy Sand Castings

ASTM B 108 (1996) Aluminum-Alloy Permanent Mold Castings

ASTM B 209 (1996) Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B 221 (1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

ASTM D 3841 (1992) Glass-Fiber-Reinforced Polyester Plastic Panels

ASTM E 84 (1996a) Surface Burning Characteristics of Building Materials

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 (1994) Structural Welding Code - Steel

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 505 (1988) Metal Finishes Manual for Architectural and Metal Products; Section: Applied Coatings

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE AMS 3611 (1994; Rev D) Plastic Sheet, Polycarbonate General Purpose

1.2 GENERAL

Exterior signage shall be of the size and type shown on the drawings, shall conform to the requirements specified herein, and shall be provided at the locations indicated. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Materials and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.3 NOT USED

1.4 DELIVERY AND STORAGE

Materials shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area.

PART 2 PRODUCTS

2.1 COLOR, FINISH, AND CONTRAST

Color of products shall be as shown on Signage Schedule on Sheet A-29.

2.2 NOT USED

2.3 ALUMINUM ALLOY PRODUCTS

Aluminum alloy products shall conform to ASTM B 209 for sheet or plate, ASTM B 221 for extrusions and ASTM B 26 or ASTM B 108 for castings. Aluminum extrusions shall be provided at least 1/8 inch thick and aluminum plate or sheet at least 16 gauge, 0.0508 inch thick.

2.4 ORGANIC COATING

Surfaces shall be cleaned, primed, and given a semi-gloss baked enamel finish in accordance with NAAMM AMP 505 with total dry film thickness not less than 1.2 mils.

2.5 STEEL PRODUCTS

Structural steel products shall conform to ASTM A 36. Sheet and strip steel products shall conform to ASTM A 570.

2.6 CAST METAL

Components shall be fabricated with sharp corners, flat faces, and accurate profiles. Burrs and rough spots shall be removed and polished. Faces shall be finished to a uniform high luster.

2.6.1 Cast Aluminum

Cast aluminum shall be in accordance with ASTM B 108.

## 2.7 VINYL SHEETING FOR GRAPHICS

Vinyl sheeting shall be in accordance with the flammability requirements of ASTM E 84 and shall be a minimum 0.003 inch film thickness. Film shall include a precoated pressure sensitive adhesive backing, Class 1, or positionable pressure sensitive adhesive backing, Class 3.

## 2.8 NOT USED

## 2.9 FIBER-REINFORCED POLYESTER (FRP)

Fiber-reinforced polyester (FRP) shall be in accordance with ASTM D 3841, Type II, Grade 1, Class 124.

## 2.10 ACRYLIC SHEET

Acrylic sheet shall be in accordance with the flammability requirements of ASTM E 84 and shall conform to ANSI Z97.1.

## 2.11 POLYCARBONATE SHEET

Polycarbonate sheet shall conform to SAE AMS 3611.

## 2.12 ANCHORS AND FASTENERS

Exposed anchor and fastener materials shall be compatible with metal to which applied and shall match in color and finish.

## 2.13 SHOP FABRICATION AND MANUFACTURE

### 2.13.1 Workmanship

Work shall be assembled in the shop, insofar as practicable, ready for installation at the site. Work that cannot be shop assembled shall be given a trial fit in the shop to ensure proper field assembly. Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Welding to or on structural steel shall be in accordance with AWS D1.1. Welding shall be continuous along the entire area of contact. Exposed welds shall be ground smooth. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable. Items specified to be galvanized shall be by hot-dip process after fabrication if practicable. Galvanization shall be in accordance with ASTM A 123 and ASTM A 653 or ASTM A 653M, as applicable. Other metallic coatings of steel sheet shall be in accordance with ASTM A 924 or ASTM A 924M. Joints exposed to the weather shall be formed to exclude water. Drainage and weep holes shall be included as required to prevent condensation buildup.

### 2.13.2 Dissimilar Materials

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic or corrosive action.

### 2.13.3 Shop Painting

Surfaces of miscellaneous metal work, except nonferrous metal, corrosion resisting steel, and zinc-coated work, shall be given one coat of zinc-molybdate

primer or an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Surfaces of items to be embedded in concrete shall not be painted. Upon completion of work, damaged surfaces shall be recoated.

## 2.14 SURFACE MOUNTED

### 2.14.1 NOT USED

### 2.14.2 Exterior Sheeting Panels

Modular panels shall be provided in sizes shown on drawings. Panels shall be fabricated a minimum of 0.090 inch thick aluminum. Panels shall be heliarc welded to framing system. Finish for metal panels shall be semi-gloss baked enamel two-component acrylic polyurethane.

### 2.15 NOT USED

### 2.16 NOT USED

## 2.17 GRAPHICS FOR SURFACE MOUNTED TYPE SIGNS

### 2.17.1 Graphics

Signage graphics shall conform to the following:

- a. Pressure sensitive precision cut vinyl letters with reflecting surface shall be provided.

### 2.17.2 Messages

See signage schedule on drawings for message content. Typeface: Helvetica medium. Type size as indicated.

## 2.18 PRESSURE SENSITIVE LETTERS

Precision cut vinyl letters shall be provided. Edges and corners of finished letter forms and graphics shall be true and clean.

### 2.18.1 Typeface

Typeface shall be helvetica medium.

### 2.18.2 Size

Letter size shall be as indicated.

### 2.19 NOT USED

### 2.20 NOT USED

### 2.21 NOT USED

## PART 3 EXECUTION

### 3.1 INSTALLATION

Signs shall be installed in accordance with approved manufacturer's instructions at locations shown on the drawings. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs mounted on other surfaces shall not be installed until finishes on such surfaces have been completed.

#### 3.1.1 Anchorage

Anchorage shall be in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or indicated shall include slotted inserts, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

#### 3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware shall be adjusted for proper operation. Sign surfaces shall be cleaned in accordance with manufacturer's instructions.

--END OF SECTION--



## SECTION C-10440

### INTERIOR SIGNAGE

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1980) Designation System for Aluminum Finishes

AA PK-1 (1989) Registration Record of Aluminum Association Alloy Designations and Chemical Composition Limits for Aluminum Alloys in the Form of Castings and Ingot

AA SAA-46 (1978) Standards for Anodized Architectural Aluminum

##### AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1 (1984; Rev 1994) Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings

##### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 221 (1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

##### 1.2 GENERAL

Interior signage shall be of the sizes and types shown on the drawings, shall conform to the requirements specified herein, and shall be provided at the locations indicated. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Signs shall be the standard product of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening.

##### 1.3 NOT USED

##### 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area.

##### 1.5 EXTRA STOCK

The Contractor shall provide extra stock of the following: 60 pressure-sensitive letters in each color and size for sign type BB2. 5 changeable message strips for sign type BB2.

#### PART 2 PRODUCTS

##### 2.1 COLOR, FINISH, AND CONTRAST

Color shall be as shown on signage Schedule on Sheet A-29.

## 2.2 NOT USED

## 2.3 ALUMINUM ALLOY PRODUCTS

Aluminum extrusions shall be at least 1/8 inch thick, and aluminum plate or sheet shall be at least 0.0508 inch thick. Extrusions shall conform to ASTM B 221. Where anodic coatings are specified, alloy shall conform to AA PK-1 alloy designation 514.0. Exposed anodized aluminum finishes shall be as shown and shall conform to AA SAA-46.

### 2.3.1 Anodic Coating

Anodized finish shall conform to AA DAF-45 as follows:

a. Clear (natural) designation AA-M10-C22-A31, Architectural Class II, 0.4 mil or thicker.

### 2.3.2 NOT USED

## 2.4 VINYL SHEETING FOR GRAPHICS

Vinyl sheeting for graphics shall be a minimum 0.003 inch film thickness. Film shall include a precoated pressure sensitive adhesive backing.

## 2.5 ACRYLIC SHEET

Acrylic sheet for panels and components shall conform to ANSI Z97.1.

## 2.6 PLAQUE SIGNS

Plaque signs shall be a modular type signage system. Signs shall be fabricated of Type ES laminated thermosetting plastic suitable for engraving conforming to ANSI Z97.1.

### 2.6.1 Standard Modular Plaque Signs

Plaque signs shall consist of matte finish acrylic plastic, thickness and size as shown. Corners of signs shall be squared.

### 2.6.2 Modular Changeable Message Strip Plaque Signs

Changeable message strip plaque signs shall consist of cast acrylic back laminated to matte finish laminated thermosetting Type ES plastic face with message slots, as detailed, for insertion of changeable message strips. Thickness and size of signs shall be as shown on the drawings. Individual 1/16 inch thick message strips to permit removal, change, and reinsertion shall be provided as detailed. Corners of signs shall be squared.

### 2.6.3 Type of Mounting For Plaque Signs

Extruded aluminum brackets, in finish as shown, shall be furnished for hanging, projecting, and double-sided signs. Mounting for framed, hanging, and projecting signs shall be by holes and screws. Surface mounted signs shall be provided with 1/16 inch thick vinyl foam tape.

## 2.7 GRAPHICS

### 2.7.1 NOT USED

### 2.7.2 Graphics Application

Signage graphics shall conform to the following:

a. Pressure sensitive precision cut vinyl letters shall be provided. Edges and corners of finished letter forms and graphics shall be true and clean.

b. Message shall be applied to panel using the silkscreen process. Silkscreened images shall be executed with photo screens prepared from original art. No handcut screens will be accepted. Original art shall be defined as artwork that is a first generation reproduction of the specified art. Edges and corners shall be clean.

#### 2.7.3 Messages

See schedule for message content, typeface and type size.

#### 2.8 NOT USED

#### 2.9 ANCHORS AND FASTENERS

Exposed anchor and fastener materials shall be compatible with metal to which applied and shall have matching color and finish. Anchorage system shall be of the type recommended by the manufacturer of the indicated substrate. Where recommended by signage manufacturer, foam tape pads may be used for anchorage. Foam tape pads shall be minimum 1/16 inch thick closed cell vinyl foam with adhesive backing. Adhesive shall be transparent, long aging, high tech formulation on two sides of the vinyl foam. Adhesive surfaces shall be protected with a 5 mil green flatstock treated with silicone. Foam pads shall be sized for the signage as per signage manufacturer's recommendations.

#### 2.10 FABRICATION AND MANUFACTURE

##### 2.10.1 Workmanship

Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable.

##### 2.10.2 Dissimilar Materials

Where dissimilar metals are in contact, the surfaces will be protected to prevent galvanic or corrosive action.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Signs shall be installed in accordance with approved manufacturer's instructions at locations shown on the drawings. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs on doors or other surfaces shall not be installed until finishes on such surfaces have been installed.

##### 3.1.1 Anchorage

Anchorage shall be in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or indicated shall include slotted inserts, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

##### 3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Sign surfaces shall be cleaned in accordance with the manufacturer's approved instructions.

--END OF SECTION--

## SECTION C-10508

### METAL LOCKERS

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN SOCIETY FOR TESTING OF MATERIALS (ASTM)

ASTM A446	Steel Sheet, Zinc-coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.
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##### 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-04 Drawings

Locker Units; FIO.

Drawings shall show plans, elevations, details of construction, hardware, mountings and anchorings.

##### SD-14 Samples

Locker Units; FIO.

Manufacturer's standard color charts and color samples.

#### PART 2 PRODUCTS

##### 2.1 LOCKER UNITS

2.1.1 Sheet Steel: Mild, cold-rolled, levelled steel; of the following minimum thickness:

- a. Body and shelf gauge: 24 gauge.
- b. Doors: 16 gauge.
- c. Door Inner Faces: 16 gauge.
- d. Door Frames: 16 gauge.
- e. Hinges: 14 gauge.
- f. Base, top, trim: 22 gauge.

##### 2.1.2 Accessories:

Each locker shall have two double prong wall hooks, metal number plate and rubber bumper.

##### 2.1.3 Fabrication:

- a. Locker Units Double Tier: 12 inches wide by 15 inches deep x 30 inches high per opening.

- b. Bodies: Formed and flanged with stiffener ribs; electrically spot welded.
- c. Door Frame: Formed channel shape, welded and ground flush, welded to body.
- d. Doors: Welded inner and outer faces; 1-3/16 inch, 30 mm thickness; channel reinforced top and bottom with intermediate stiffener ribs. Finish edges smooth.
- e. Hinges: Three for doors 42 inches and higher, two for doors under 42 inches (1050 mm) high. Weld securely to unit body and river to unit door.
- f. Locking handle to accommodate padlock. Locking device supplied by owner.
- g. End panels, filler panels, and sloped metal tops to close off all openings.
- h. Ventilation openings located at top and bottom of each locker.
- i. Finish edges smooth without burrs.

#### 2.1.4 Finishes:

- a. Clean, degrease and neutralize metal; prime and finish with two coats of baked enamel.
- b. Paint locker doors and bodies. Locker door and body of one color throughout.
- c. Color: One color as selected from manufacturer's standard range.

#### 2.2 NOT USED

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- a. Install lockers secure, plumb, square, and in line. Set on prepared base provided.
- b. Anchor lockers with appropriate anchor devices to suit materials encountered.
- c. Bolt adjoining locker units together to provide rigid installation.
- d. Install end panels, filler panels, and sloped tops to completely close off openings.

-- End of Section --

## SECTION C-10520

### FIRE EXTINGUISHER CABINETS

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

UFPA 10

Portable Fire Extinguishers

##### 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Fire Extinguisher Cabinets; FIO.

Drawings shall show plans, elevations, details of construction, hardware, mountings, and anchorings.

#### PART 2 PRODUCTS

##### 2.1 FIRE EXTINGUISHER CABINETS:

Fire extinguisher cabinets shall be furnished and installed in accordance with NFPA No. 10, 10A and 10L and U.L. Standards. Fire extinguishers will be 10# dry chemical type, for use on A, B and C fires (4A-60BC) and are not included for this contract. Cabinet size shall be 24" h x 9 1/2" w x 6" deep surface mounted.

2.1.1 Wall Brackets: Shall be designed to fit extinguishers and shall hold extinguishers firmly and securely in place, but shall provide for easy removal.

2.1.2 Cabinets: Surface mounted steel cabinet with baked enamel finish. Steel door shall be baked enamel solid type, 30 gauge, with white silk screened words "Fire Extinguisher" arranged vertically.

Cabinet construction shall include:

- a. Continuous door hinge
- b. Zinc plated pull handle
- c. Self-adjusting roller catch
- d. One (1) bracket in each cabinet.

#### PART 3 EXECUTION

##### 3.1 INSTALLATION

All fire extinguisher cabinets and mounting brackets are to be installed at the locations shown on the drawings, or as otherwise indicated. Accomplish a neat finished job, consistent with the requirements for the use of the equipment.

-- End of Section --



## SECTION C-10800

### TOILET ACCESSORIES

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1036 (1991) Flat Glass

##### COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-2380 (Basic) Dispenser, Paper Towel

CID A-A-2398 (Rev B) Curtain, Shower and Window  
(Metric - SI)

##### 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation, submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-01 Data

Finishes; FIO. Accessory Items; FIO.

Manufacturer's descriptive data and catalog cuts indicating materials of construction, fasteners proposed for use for each type of wall construction, and mounting instructions.

##### 1.3 DELIVERY, STORAGE, AND HANDLING

Toilet accessories shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area protected from construction damage and vandalism.

#### PART 2 PRODUCTS

##### 2.1 MANUFACTURED UNITS

Toilet accessories shall be provided where indicated in accordance with paragraph SCHEDULE. Porcelain type, tile-wall accessories are specified in Section C-09310 CERAMIC TILE. Each accessory item shall be complete with the necessary mounting plates, shall be of sturdy construction with corrosion resistant surface.

###### 2.1.1 Anchors and Fasteners

Anchors and fasteners shall be capable of developing a restraining force commensurate with the strength of the accessory to be mounted and shall be suited for use with the supporting construction. Exposed fasteners shall be of tamperproof design and shall be finished to match the accessory.

###### 2.1.2 Finishes

Except where noted otherwise, finishes on metal shall be provided as follows:

<u>Metal</u>	<u>Finish</u>
Stainless steel	No. 4 satin finish
Carbon steel, copper alloy, and brass	Chromium plated, bright

## 2.2 ACCESSORY ITEMS

Accessory items shall conform to the requirements specified below.

2.2.1 NOT USED

2.2.2 NOT USED

2.2.3 NOT USED

2.2.4 NOT USED

2.2.5 NOT USED

2.2.6 NOT USED

2.2.7 Paper Towel Dispenser (PTD)

Paper towel dispenser shall conform to CID A-A-2380, Type I, shall be constructed of not less than 0.269 inch Type 304 stainless steel, and shall be surface mounted. Dispenser shall have a towel compartment and a mirror door and liquid soap dispenser. Locking mechanism shall be tumbler key lock.

2.2.8 Combination Paper Towel Dispenser/Waste Receptacle Units (PTDWR)

Dispenser/receptacle shall be semi-recessed and shall have a capacity of 600 sheets of C-fold, single-fold, or quarter-fold towel. Waste receptacle shall be designed to be locked in unit and removable for service. Locking mechanism shall be tumbler key lock. Waste receptacle shall have a capacity of 18 gallons. Unit shall be fabricated of not less than 0.030 inch stainless steel welded construction with all exposed surfaces having a satin finish. Waste receptacle that accepts reusable liner standard for unit manufacturer shall be provided.

2.2.9 Sanitary Napkin Disposer (SND)

Sanitary napkin disposal shall be constructed of Type 304 stainless steel with removable leak-proof receptacle for disposable liners. Fifty disposable liners of the type standard with the manufacturer shall be provided. Receptacle shall be retained in cabinet by tumbler lock. Disposer shall be provided with a door for inserting disposed napkins, and shall be partition mounted.

2.2.10 NOT USED

2.2.11 Shower Curtain (SC)

Shower curtain shall conform to CID A-A-2398, Style I, size to suit conditions.

2.2.12 Shower Curtain Rods (SCR)

Shower curtain rods shall be Type 304 stainless steel 1-1/4 inch OD by 0.049 inch minimum straight to meet installation conditions.

2.2.13 NOT USED

2.2.14 NOT USED

2.2.15 NOT USED

2.2.16 NOT USED

2.2.17 NOT USED

2.2.18 NOT USED

2.2.19 NOT USED

2.2.20 Toilet Tissue Dispenser (TTD)

Toilet tissue holder shall be Type II - surface mounted with two rolls of tissue mounted horizontally. Cabinet shall be stainless steel, satin finish.

2.2.21 NOT USED

2.2.22 Waste Receptacle (WR)

Waste receptacle shall be Type 304 stainless steel, designed for surface mounting. Reuseable liner, of the type standard with the receptacle manufacturer, shall be provided. Capacity shall be not less than 3 cubic feet. Receptacles with push doors and doors for access to the waste compartment shall have continuous hinges. Locking mechanism shall be tumbler key lock.

2.2.23 NOT USED

2.2.24 NOT USED

2.2.25 NOT USED

2.2.26 Coat Hook with Bumper (CH/B)

Coat hook with bumper shall be solid aluminum casting or stainless steel with satin finish. Rubber bumper shall be provided to protect wall and partition finishes.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Toilet accessories shall be securely fastened to the supporting construction in accordance with the manufacturer's approved instructions. Accessories shall be protected from damage from the time of installation until acceptance.

#### 3.2 SCHEDULE

##### Accessories Required

	Room or Space	PTDHC	PTD	SND	SCR/SC	WR	TTD	CH/B
Bldg.	108 Women	-	1	1	1	1	1	1
B & C	110 Men	-	1	-	1	1	1	1
	208 Men	-	1	-	-	1	1	1
	209 Women	-	1	1	-	1	1	1
Bldg.	109 Women	1	2	3	-	-	3	3
D	110 Men	-	1	-	-	1	1	1

-- End of Section --

## SECTION C-12390

### COUNTERTOPS

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publication listed below forms a part of this specification to the extent referenced. The publication is referred to in the text by basic designation only.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3 (1991) High-Pressure Decorative Laminates

##### 1.2 DESIGN

Countertops and related wood framing and wood posts shall be fabricated and finished as indicated.

##### 1.3 NOT USED

##### 1.4 DELIVERY AND STORAGE

Countertops shall be delivered to the jobsite wrapped in a protective covering and shall be stored in an adequately ventilated, dry location that is free of dust, water, or other contaminants and in a manner to permit access for inspection and handling. Countertops shall be handled carefully to prevent damage. Damaged items that cannot be restored to like-new condition shall be replaced.

#### PART 2 PRODUCTS

##### 2.1 NOT USED

##### 2.2 COUNTERTOPS AND BACKSPLASH

###### 2.2.1 General

Countertop and backsplash shall be constructed of 3/4 inch thick plywood or 3/4 inch thick, 45 pound density particle board core and shall be fully formed type. Fully formed type or square edge shall be a unit with shaped edges using wood nose molding at counter edge and shall include a separate backsplash. Edging and trim shall consist of plastic laminate cut and fitted to all exposed edges. End splashes constructed of 3/4 inch plywood or 3/4 inch thick, 45 pound density particle board core shall be supplied.

###### 2.2.2 NOT USED

##### 2.3 FINISH

###### 2.3.1 NOT USED

###### 2.3.2 NOT USED

###### 2.3.3 Melamine Laminates on Countertops

Continuous sheets of longest lengths practicable shall be provided. Joints in surface sheeting shall be tight and flush and held to a practicable minimum. When the countertop and backsplash are two separate units, GP50 plastic laminate shall be used. Plastic laminate shall conform to the requirements of NEMA LD 3

and plastic laminate adhesive shall be contact type applied to both surfaces. For fully formed and cove type countertops, the post-forming plastic laminate shall not be bent to a radius smaller than the limit recommended by the plastic manufacturer. Design, color, and finish shall be selected from manufacturer's standard.

2.3.4 NOT USED

2.4 NOT USED

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Countertops shall be installed level and plumb and shall be attached to the walls or floors as indicated.

--End of Section--

## SECTION C-13080

### SEISMIC PROTECTION FOR MECHANICAL, ELECTRICAL EQUIPMENT

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1996) Carbon Structural Steel
ASTM A 53	(1995a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 153	(1996) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM A 500	(1993) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 563	(1994) Carbon and Alloy Steel Nuts
ASTM A 603	(1994) Zinc-Coated Steel Structural Wire Rope
ASTM A 653	(1996) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM E 488	(1990) Strength of Anchors in Concrete and Masonry Elements
ASTM E 580	(1991) Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Seismic Restraint

#### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1	(1981; Supple 1991; R 1992) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(1987; R 1993) Square and Hex Nuts (Inch Series)

#### INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO-01	(1994) Uniform Building Code (3 Vol.)
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#### SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION(SMACNA)

SMACNA-12	(1991; Appx E, 1993) Seismic Restraint Manual Guidelines for Mechanical Systems
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UNDERWRITERS LABORATORIES (UL)

UL 1570 (1995) Fluorescent Lighting Fixtures

UL 1571 (1991; Rev thru Mar 95) Incandescent Lighting Fixtures

1.2 SYSTEM DESCRIPTION

1.2.1 General

The requirements for seismic protection measures described in this section shall be applied to mechanical/electrical equipment and systems specified herein. Seismic protection requirements shall be in accordance with ICBO-01 using an importance factor of 1.0 and shall be provided in addition to any other requirements called for in other sections of these specifications. This facility shall be designed as being in seismic zone 2A; no other zone values shall be used to establish bracing requirements. Lateral support against earthquake induced forces shall be accomplished by positive attachments without consideration of friction resulting from gravity loads.

1.2.2 Mechanical/Electrical Equipment

Mechanical/electrical equipment shall include the following items to the extent required on the drawings or in other sections of these specifications:

Boilers and furnaces	Storage Tanks for Waste Oil
Water Heaters	Water, Oil and Gas Piping
Expansion Air Separator Tanks	Heat Exchangers
Bridge Cranes	Air Compressors
Control Panels	Air Handling Units
Pumps with Motors	Switchgear
Light Fixtures	Unit Substations
Motor Control Centers	Transformers
Switchboards (Floor Mounted)	Suspended Ceiling Assemblies
Ducts	Unit Heaters
Exhaust and Return Fans	Radiant Heaters
Condensing Units	

1.2.3 Mechanical/Electrical Systems

The following mechanical and electrical systems shall be installed as required on the drawings and other sections of these specifications and shall be seismically protected in accordance with this specification:

All Piping Inside the Building in Accordance With This Specification

All Water Supply Systems

Storm and Sanitary Sewer Systems

All Process Piping

Refrigerant Piping Outside the Building

1.2.4 NOT USED

1.2.5 Exclusion



Seismic protection of piping for fire protection systems shall be installed as specified in Sections C-15330 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION, C-15331 DRY PIPE SPRINKLER SYSTEM, FIRE PROTECTION.

#### 1.2.6 Pipes and Ducts Requiring No Special Seismic Restraints

Seismic restraints may be omitted from the following installations:

- a. Gas piping less than 1 inch inside diameter.
- b. Piping in boiler and mechanical equipment rooms less than 1-1/4 inches inside diameter.
- c. All other piping less than 1-1/2 inches inside diameter.
- d. Electrical conduit less than 2-1/2 inches inside diameter.
- e. Rectangular air handling ducts less than 4 square feet in cross sectional area.
- f. Round air handling ducts less than 18 inches in diameter.
- g. Piping suspended by individual hangers 12 inches or less in length from the top of pipe to the bottom of the supporting structural member where the hanger is attached, except as noted below.
- h. Ducts suspended by hangers 12 inches or less in length from the top of the duct to the bottom of the supporting structural member, except as noted below.

In exemptions g. and h. all hangers shall meet the length requirements. If the length requirement is exceeded by one hanger in the run, the entire run shall be braced.

#### 1.2.7 All Other Interior Piping, Conduit, and Ducts

Interior piping, conduit, and ducts not covered by paragraphs Exclusion or Pipes and Ducts Requiring No special Seismic Restraints shall be seismically protected in accordance with the provisions herein.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-01 Data

Bridge Cranes; GA.

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

SD-04 Drawings

Flexible Couplings or Joints; GA.

Resilient Vibration Isolation Devices; GA.

Bridge Cranes; GA.

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

#### SD-13 Certificates

Flexible Ball Joints; FIO.

Flexible ball joints shall be certified to be suitable for the service intended by the manufacturer, based on not less than 2 years' satisfactory operation in a similar application.

## PART 2 PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall conform to the requirements specified below:

#### 2.1.1 Bolts and Nuts

Squarehead and hexhead bolts, and heavy hexagon nuts, ASME B18.2.1, ASME B18.2.2, or ASTM A 307 for bolts and ASTM A 563 for nuts. Bolts and nuts used underground and/or exposed to weather shall be galvanized in accordance with ASTM A 153.

#### 2.1.2 Sway Bracing

Material used for members listed in this section and on the drawings, shall be structural steel conforming with the following:

- a. Plates, rods, and rolled shapes, ASTM A 36.
- b. Light gauge angles, less than 1/4 inch thickness, ASTM A 653.

#### 2.1.3 Flexible Couplings

Flexible couplings shall have same pressure and temperature ratings as adjoining pipe specified.

##### 2.1.3.1 Flexible Ball Joints

Flexible ball joints shall have cast or wrought steel casing and ball parts capable of 360-degree rotation plus not less than 15-degree angular movement.

##### 2.1.3.2 Flexible Mechanical Joints

a. Mechanical couplings for steel or cast iron pipe shall be of the sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movement caused by expansion, contraction, slight settling or shifting of the ground, minor variations in trench gradients, and traffic vibrations. Where permitted in other sections of these specifications, joints utilizing split-half couplings with grooved or shouldered pipe ends may be used.

b. Sleeve-type couplings shall be used for joining plain-end pipe sections. The coupling shall consist of one steel middle ring, two steel followers, two gaskets, and necessary steel bolts and nuts to compress the gaskets. Underground bolts shall be high-strength type as specified above.

#### 2.1.4 Lighting Fixture Supports

Fixture supports shall be malleable iron. Lighting fixtures and supports shall conform to UL 1570 or UL 1571 as applicable.

## PART 3 EXECUTION

### 3.1 BRACING AND COUPLING

Bracing and coupling shall conform to the arrangements shown. Provisions of this paragraph apply to all piping within a 5 foot line around outside of building unless buried in the ground. Piping grouped for support on trapeze-type hangers shall be braced at the same intervals as determined by the smallest diameter pipe of the group. No trapeze-type hanger shall be secured with less than two 1/2 inch bolts. Bracing rigidly attached to pipe flanges, or similar, shall not be used where it would interfere with thermal expansion of piping.

### 3.2 BUILDING DRIFT

Sway braces for a run shall not be attached to two dissimilar structural elements of a building that may respond differentially during an earthquake unless a flexible joint is provided. Joints capable of accommodating seismic displacements shall be provided where rigidly supported pipes connect to equipment with vibration isolators. For threaded piping, swing joints shall be provided. For piping with manufactured ball joints the seismic drift shall be 0.015 feet per foot of height above the base where the seismic separation occurs; this drift value shall be used in place of the expansion given in the manufacturer's selection table.

### 3.3 FLEXIBLE COUPLINGS OR JOINTS

#### 3.3.1 Building Piping

Flexible couplings or joints in building piping shall be provided at bottom of all pipe risers larger than 3-1/2 inches in diameter. Flexible couplings or joints shall be braced laterally without interfering with the action of the flexible coupling or joint. Cast iron waste and vent piping need only comply with these provisions when caulked joints are used. Flexible bell and spigot pipe joints using rubber gaskets or no-hub fittings may be used at each branch adjacent to tees and elbows for underground waste piping inside of building to comply with these requirements.

#### 3.3.2 Underground Piping

Underground piping and 4 inch or larger conduit, except heat distribution system, shall have flexible couplings installed where the piping enters the building. The couplings shall accommodate 0.010 inches of relative movement between the pipe and the building in any direction. Additional flexible couplings shall be provided where shown on the drawings.

### 3.4 PIPE SLEEVES

Pipe sleeves in interior non-fire rated walls shall be sized as indicated on the drawings to provide clearances that will permit differential movement of piping without the piping striking the pipe sleeve.

### 3.5 SPREADERS

Spreaders shall be provided between adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 4 inches apart. Spreaders shall be applied at same interval as sway braces at an equal distance between the sway braces. If rack type hangers are used where

the pipes are restrained from contact by mounting to the rack, spreaders are not required for pipes mounted in the rack. Spreaders shall be applied to surface of bare pipe and over insulation on insulated pipes utilizing high-density inserts and pipe protection shields in accordance with the requirements of Section C-15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

### 3.6 ANCHOR BOLTS

#### 3.6.1 Cast-In-Place

Floor or pad mounted equipment shall use cast-in-place anchor bolts, except as specified below. One nut shall be provided on each bolt. Anchor bolts shall conform to the following tabulation for the various equipment weights and specified seismic zone or the manufacturer's installation recommendations, whichever is the most stringent, unless otherwise shown on the drawings. Anchor bolts that exceed the normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation shall be increased in depth to accommodate bolt lengths.

#### 3.6.2 Minimum Bolt Sizes, Cast-In-Place Anchor Bolts

Maximum Equipment Weight (Pounds)	Minimum Bolt Sizes (Inches)*				
	<u>Zone 4</u>	<u>Zone 3</u>	<u>Zone 2A</u>	<u>Zone 2B</u>	<u>Zone 1</u>
500	1/2	1/2	1/2	1/2	1/2
1,000	1/2	1/2	1/2	1/2	1/2
5,000	1/2	1/2	1/2	1/2	1/2
10,000	1/2	1/2	1/2	1/2	1/2
20,000	1/2	1/2	1/2	1/2	1/2
30,000	5/8	1/2	1/2	1/2	1/2
50,000	7/8	5/8	1/2	1/2	1/2
100,000	**	**	5/8	7/8	1/2

\*Based on four bolts per item, a minimum embedment of 12 bolt diameters, a minimum bolt spacing of 16 bolt diameters and a minimum edge distance of 12 bolt diameters. Equivalent total cross-sectional area shall be used when more than four bolts per item are provided. Anchor bolts shall conform to ASTM A 307. Anchor bolts shall have an embedded straight length equal to at least 12 times nominal diameter of the bolt.

\*\*Equipment weighing more than 50,000 lb in Zones 3 and 4 shall have at least six bolts per item.

#### 3.6.3 Expansion or Chemically Bonded Anchors

Expansion or chemically bonded anchors shall not be used unless test data in accordance with ASTM E 488 has been provided to verify the adequacy of the specific anchor and application. The expansion anchor size shall be not less than that required in paragraph Minimum Bolt Sizes, Cast-In-Place Anchor Bolts. Expansion and chemically bonded anchors shall be installed in accordance with the manufacturer's recommendations. The allowable forces shall be adjusted for the spacing between anchor bolts and the distance between the anchor bolt and the nearest edge, as specified by the manufacturer.

##### 3.6.3.1 General Testing

Expansion and chemically bonded anchors shall be tested in place after installation. The tests shall occur not more than 24 hours after installation

of the anchor and shall be conducted by an independent testing agency; testing shall be performed on random anchor bolts as described below.

#### 3.6.3.2 Torque Wrench Testing

Torque wrench testing shall be done on not less than 50 percent of the total installed expansion anchors and at least one anchor for every piece of equipment containing more than two anchors. The test torque shall equal the minimum required installation torque as required by the bolt manufacturer. Torque wrenches shall be calibrated at the beginning of each day the torque tests are performed. Torque wrenches shall be recalibrated for each bolt diameter whenever tests are run on bolts of various diameters. The applied torque shall be between 20 and 100 percent of wrench capacity. The test torque shall be reached within one half turn of the nut, except for 3/8 inch sleeve anchors which shall reach their torque by one quarter turn of the nut. If any anchor fails the test, similar anchors not previously tested shall be tested until 20 consecutive anchors pass. Failed anchors shall be retightened and retested to the specified torque; if the anchor still fails the test it shall be replaced.

#### 3.6.3.3 NOT USED

### 3.7 RESILIENT VIBRATION ISOLATION DEVICES

Selection of anchor bolts for vibration isolation devices and/or snubbers for equipment base and foundations shall follow the same procedure as in paragraph ANCHOR BOLTS except that an equipment weight equal to five times the actual equipment weight shall be used.

#### 3.7.1 Resilient and Spring-Type Vibration Devices

Vibration isolation devices shall be selected so that the maximum movement of equipment from the static deflection point shall be 0.5 inches.

#### 3.7.2 NOT USED

### 3.8 SWAY BRACES FOR PIPING

Sway braces shall be provided to prevent movement of the pipes under seismic loading. Braces shall be provided in both the longitudinal and transverse directions, relative to the axis of the pipe. The bracing shall not interfere with thermal expansion requirements for the pipes as described in other sections of these specifications.

#### 3.8.1 Transverse Sway Bracing

Transverse sway bracing for steel and copper pipe shall be provided at intervals not to exceed those given in the tabulation below as modified for each seismic zone. All runs shall have a minimum of two transverse braces. Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section C-15400 PLUMBING, GENERAL PURPOSE.

### 3.8.2 Maximum Span for Transverse Sway Braces in Seismic Zone 4

Pipe Diameter	Std. Wgt. Steel Pipe - 40S		Ex. Strong Steel Pipe - 80S		Copper Tube Type L	
(in.)	*L(ft.)	**F(lbs.)	*L(ft.)	**F(lbs.)	*L(ft.)	**F(lbs.)
1	22	70	22	80	11	17
1-1/2	25	140	26	180	12	35
2	29	220	30	290	14	70
2-1/2	32	380	33	460	15	110
3	34	550	35	710	17	150
3-1/2	36	730	38	930	18	220
4	39	960	40	1,200	19	300
5	41	1,440	44	1,900	20	470
6	45	2,120	46	2,750	22	730
8	49	3,740	54	5,150	26	1,550
10	54	6,080	59	7,670	28	2,630
12	58	8,560	61	10,350	31	3,950

\*L = Maximum span between lateral supports multiplied by 1.25 for Zone 2A.

\*\*F = Horizontal force on the brace multiplied by 0.5 for Zone 2A.

NOTE: Bracing shall consist of at least one vertical angle 2 x 2 x 16 gauge and one diagonal angle of the same size.

### 3.8.3 Longitudinal Sway Bracing

Longitudinal sway bracing shall be provided at 40 foot intervals except when the location of sway braces is shown on the drawings for the particular piping system. All runs shall have one longitudinal brace minimum. Sway braces shall be constructed in accordance with the drawings. Branch lines, walls, or floors shall not be used as sway braces.

### 3.8.4 Vertical Runs

Vertical runs of piping shall be braced at not more than 10 foot vertical intervals. For tubing, bracing shall be provided at no more than 4 foot spacing. Vertical braces shall be above the center of gravity of the span being braced. All sway braces shall be constructed in accordance with the drawings. Branch lines, walls, or floors shall not be used as sway braces.

### 3.8.5 Anchor Rods, Angles, and Bars

Anchor rods, angles, and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in-place concrete or masonry insert or clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as specified below. Anchor rods, angles, and bars shall not exceed lengths given in the tabulation below.

### 3.8.6 Maximum Length for Anchor Braces

Type	Size (Inches)	Maximum Length* (Feet/Inches)	Allowable Loads* (kips)
Angles	1-1/2 x 1-1/2 x 1/4	4-10	5.7
	2 x 2 x 1/4	6-6	7.8
	2-1/2 x 1-1/2 x 1/4	8-0	9.8
	3 x 2-1/2 x 1/4	8-10	10.8
	3 x 3 x 1/4	9-10	11.9
Rods	3/4	3-1	3.7
	7/8	3-8	5.0
Flat Bars	1-1/2 x 1/4	1-2	3.1
	2 x 1/4	1-2	4.1
	2 x 3/8	1-9	6.2
Pipes (40S)	1	7-0	4.1
	1-1/4	9-0	5.5
	1-1/2	10-4	6.6
	2	13-1	8.9

\*Based on the slenderness ratio of  $l/r = 200$  and ASTM A 36 steel, where  $l$  is the length of the brace and  $r$  is the least radius of gyration of the brace.

### 3.8.7 Clamps and Hangers

Clamps or hangers on uninsulated pipes shall be applied directly to pipe. Insulated piping shall have clamps or hangers applied over insulation in accordance with Section C-15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

### 3.8.8 Bolts

Bolts used for attachment of anchors to pipe and structure shall be not less than 1/2 inch diameter.

## 3.9 SWAY BRACES FOR DUCTS

### 3.9.1 Braced Ducts

Bracing details and spacing for rectangular and round ducts shall be in accordance with SMACNA-12, including Appendix E, using Seismic Hazard Level 2A and connection level C.

### 3.9.2 Unbraced Ducts

Hangers for unbraced ducts shall be positively attached to the duct within 2 inches of the top of the duct with a minimum of two #10 sheet metal screws. Unbraced ducts shall be installed with a 6 inch minimum clearance to vertical ceiling hanger wires.

### 3.10 SWAY BRACES FOR CONDUIT

Conduit shall be braced as for an equivalent weight pipe.

### 3.11 EQUIPMENT SWAY BRACING

### 3.11.1 Suspended Equipment

Equipment sway bracing shall be provided for items supported from overhead floor or roof structures. Braces shall consist of angles, rods, wire rope, bars, or pipes arranged as shown and secured at both ends with not less than 1/2 inch bolts. Braces shall conform to paragraph Maximum Length for Anchor Braces. Sufficient braces shall be provided for equipment to resist a horizontal force equal to 0.56 times the weight of equipment without exceeding safe working stress of bracing components. Details of equipment bracing shall be submitted for approval. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45-degree angle.

### 3.11.2 Floor or Pad Mounted Equipment

#### 3.11.2.1 Shear Resistance

Floor mounted equipment shall be bolted to the floor. Requirements for the number and installation of bolts to resist shear forces shall be in accordance with paragraph ANCHOR BOLTS.

#### 3.11.2.2 Overturning Resistance

The ratio of the height of the equipment (measured from the base to the center of gravity of the equipment) to the minimum distance between anchor bolts shall be used to determine if overturning forces need to be considered in the sizing of anchor bolts. If this ratio is greater than 4.44 the bolt values in paragraph Minimum Bolt Sizes, Cast-In-Place Anchor Bolts shall not be used and calculations shall be provided to verify the adequacy of the anchor bolts for combined shear and overturning.

### 3.12 MISCELLANEOUS EQUIPMENT

#### 3.12.1 Rigidly Mounted Equipment

The following specific items of equipment to be furnished under this contract shall be constructed and assembled to withstand a horizontal lateral force of 0.11 times the operating weight of the equipment, at vertical center of gravity of the equipment without causing permanent deformation, dislocations, separation of components, or other damage, which would render the equipment inoperative for significant periods of time following an earthquake.

##### Rigidly Mounted Equipment

Boilers  
Air-Handling Units  
Substations  
Transformers  
Switch Boards and Switch Gears  
Motor Control Centers  
Free Standing Electric Motors

#### 3.12.2 Nonrigid or Flexibly-Mounted Equipment



The following specific items of equipment to be furnished shall be constructed and assembled to resist a horizontal lateral force of 0.56 times the operating weight of the equipment at the vertical center of gravity of the equipment.

### 3.13 LIGHTING FIXTURES IN BUILDINGS

Lighting fixtures and supports shall conform to the following:

#### 3.13.1 Pendant Fixtures

Loop and hook or swivel hanger assemblies for pendant fixtures shall be fitted with a restraining device to hold the stem in the support position during earthquake motions. Pendant-supported fluorescent fixtures shall also be provided with a flexible hanger device at the attachment to the fixture channel to preclude breaking of the support. The motion of swivels or hinged joints shall not cause sharp bends in conductors or damage to insulation.

#### 3.13.2 Recessed Fluorescent Fixtures

Recessed fluorescent individual or continuous-row mounted fixtures shall be supported by a seismic-resistant suspended ceiling support system and shall be fastened thereto at each corner of the fixture with bolts or approved clips; or shall be provided with fixture support wires attached to the building structural members using two wires for individual fixtures, attached to opposite corners, and one wire per unit of continuous row mounted fixtures. Each wire support shall be capable of supporting four times the weight of the fixture. Recessed lighting fixtures not over 56 pounds in weight and suspended or pendant-hung fixtures not over 20 pounds in weight may be supported by and attached directly to the ceiling system runners by a positive attachment such as screws or bolts, number and size as required by design seismic zone. Fixture accessories, including louvers, diffusers, and lenses shall have lock or screw attachments.

#### 3.13.3 Assembly Mounted on Outlet Box

A supporting assembly that is intended to be mounted on an outlet box shall be designed to accommodate mounting features on 4 inch boxes, 3 inch plaster rings, and fixture studs.

#### 3.13.4 Surface-Mounted Fluorescent Fixtures

Surface-mounted fluorescent individual or continuous-row fixtures shall be attached to a seismic-resistant ceiling support system. Fixture support devices for attaching to suspended ceilings shall be a locking-type scissor clamp or a full loop band that will securely attach to the ceiling support. Fixtures attached to underside of a structural slab shall be properly anchored to the slab at each corner of the fixture.

#### 3.13.5 Wall-Mounted Emergency Light Unit

Each wall-mounted emergency light unit shall be secured to remain in place during a seismic disturbance.

#### 3.13.6 Lateral Force

Light fixture bracing shall be designed to resist a lateral force of 0.56 times the fixture weight.

### 3.14 SUSPENDED CEILING ASSEMBLIES

The structural members of ceiling support systems, used primarily to support acoustical tile panels or acoustical panel lay-in tiles, with or without lighting fixtures, ceiling-mounted air terminals, and ceiling-mounted services, shall conform to the following:

#### 3.14.1 Design Loads

The main runners and cross-runners and their splices and intersection connections shall be designed for two times the design load or ultimate axial tension or compression 120 pounds. The connections at the splices and intersections shall be of a mechanical interlocking type that cannot easily be disengaged. Ceiling structural systems shall be designed to withstand required vertical load as well as a lateral force of 11.3 percent of the ceiling weight. The ceiling weight shall include all lighting fixtures and other equipment that are laterally supported by the ceiling and shall be not less than 4.0 psf. Exception: Ceiling areas of 144 square feet or less surrounded by walls that connect directly to the structure above will be exempt from the lateral-load standards of this specification.

#### 3.14.2 Installation Requirements

Installation requirements shall be in accordance with ASTM E 580 except as follows:

##### 3.14.2.1 Vertical Support

Hanger wires supporting a maximum tributary ceiling area of 16 square feet shall be a minimum of 10 gauge in diameter. The size of wires supporting a tributary ceiling area greater than 16 square feet shall be substantiated by design calculations. Hanger attachment devices used in ceiling systems not exceeding 4 psf shall be capable of supporting a minimum allowable load of 300 pounds. Hanger attachment devices used in ceiling systems exceeding 4 psf shall be capable of supporting the design load and shall be substantiated by design calculations. If hangers must be splayed more than one horizontal to six vertical, the resulting horizontal force shall be offset by bracing or counter-splaying, and substantiated by design calculations.

##### 3.14.2.2 Lateral Support

In lieu of the design criteria stated above, where ceiling loads do not exceed 4 psf, lateral support for the ceiling system may be provided by four galvanized wires of minimum No. 12 gauge, as indicated in ASTM E 580, paragraph 4.4.6.

#### 3.14.3 Lighting Fixture and Air Diffuser Supports

Lighting fixture and air diffuser supports shall be designed and installed to meet the requirements of equipment supports in the preceding paragraphs of this specification with the following exceptions:

a. Recessed lighting fixtures not over 56 pounds in weight and suspended and pendent-hung fixtures not over 20 pounds in weight may be supported and attached directly to the ceiling system runners by a positive attachment such as screws or bolts.

b. Air diffusers that weigh not more than 20 pounds and that receive no tributary loading from ductwork may be positively attached to and supported by the ceiling runners.

#### 3.15 BRIDGE CRANES

Bridges cranes and monorails shall be designed to accommodate the following horizontal lateral force coefficient of 0.23 times weight, applied in any direction to the center of gravity of the equipment. The weight of such equipment need not include any live load, and the equivalent static force so computed will be assumed to act nonconcurrently with other prescribed nonseismic horizontal forces when considering the design of the crane and monorails. The crane design shall be suitable for the forces previously specified in addition to the normal horizontal loads prescribed by standards cited in other sections of these specifications.

--END OF SECTION--

SECTION C-13121  
STANDARD METAL BUILDING SYSTEMS  
DEPLOYMENT STORAGE BUILDINGS

10/91

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA-01	(1993) Aluminum Standards and Data
AA SAS-30	(1986) Aluminum Construction Manual Series - Section C-1 Specifications for Aluminum Structures

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC FCD-90	(1990) AISC Quality Certification Program Description
AISC-S303	(1992) Code of Standard Practice for Steel Buildings and Bridges
AISC-S329	(1986) Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts
AISC-S335	(1989) Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-673	(1996) Cold-Formed Steel Design Manual
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1994a) Carbon Structural Steel
ASTM A 53	(1993a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 252	(1993) Welded and Seamless Steel Pipe Piles
ASTM A 325	(1994) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 446	(1993) Steel Sheet, Zinc-Coated (Galvanized) by the Hot- Dip Process, Structural (Physical) Quality
ASTM A 463	(1994) Steel Sheet, Aluminum-Coated by the Hot-Dip Process

ASTM A 500	(1993) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(1993) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 529	(1994) High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 570	(1992; R 1993) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM A 572	(1994b) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 588	(1994) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 606	(1991a; R 1993) Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A 607	(1992a) Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled
ASTM A 618	(1993) Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 792	(1993a) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process, General Requirements
ASTM B 117	(1994) Operating Salt Spray (Fog) Testing
ASTM B 209	(1993) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(1993) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM B 241	(1995) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B 308	(1995) Aluminum-Alloy 6061-T6 Standard Structural Shapes
ASTM B 429	(1992a) Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM D 522	(1993a) Mandrel Bend Test of Attached Organic Coatings
ASTM D 714	(1987; R 1994) Evaluating Degree of Blistering of Paints
ASTM D 968	(1993) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 1308	(1987; R 1993) Effect of Household Chemicals on Clear and Pigmented Organic Finishes

ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2244	(1993) Calculation of Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(1994) Testing Water Resistance of Coatings in 100 % Relative Humidity
ASTM D 2794	(1993) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(1995) Measuring Adhesion by Tape Test
ASTM D 4214	(1989) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4397	(1991) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM E 96	(1994) Water Vapor Transmission of Materials
ASTM G 23	(1995) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1994) Structural Welding Code - Steel
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MATERIAL HANDLING INSTITUTE (MHI)

MHI CMAA 70	(1994) Electric Overhead Traveling Cranes
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METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA-01	(1996) Low Rise Building Systems Manual
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SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL  
ASSOCIATION(SMACNA)

SMACNA-1013	(1993) Architectural Sheet Metal Manual
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STEEL DOOR INSTITUTE (SDOI)

SDOI SDI-100	(1991) Standard Steel Doors and Frames
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UNDERWRITERS LABORATORIES (UL)

UL 580	(1994; Rev thru Apr 1995) Tests for Uplift Resistance of Roof Assemblies
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1.2 GENERAL

### 1.2.1 Building Configuration

Buildings shall have vertical walls and single-slope roofs. Roof slope shall be as indicated. Buildings shall be single-span structures with the following framing system: rigid frame (tapered beam or plate girder). Building dimensions shall be as standard with the manufacturer and not less than those indicated, but exceeding the indicated dimensions only by the amount of the closest standard size thereto. Eave height shall be measured from the top of the finished floor to the intersection of the insides of the roof and sidewall sheets. The clear opening between the finished floor and the bottom of the roof steel shall be as indicated.

### 1.2.2 Manufacturer

Metal building shall be the product of a recognized metal building systems manufacturer who has been in the practice of manufacturing metal buildings for a period of no less than 5 years. The manufacturer shall be chiefly engaged in the practice of designing and fabricating metal building systems. The manufacturer shall have an AISC Quality Certification, category MB in accordance with AISC FCD-90.

### 1.2.3 Installer

Erector shall have specialized experience in the erection of metal building systems for a period of at least 3 years.

## 1.3 DESIGN REQUIREMENTS

### 1.3.1 Design Conditions

Loading combinations and definitions shall be in accordance with MBMA-01. Loading criteria as set out by MBMA-01 shall apply.

#### 1.3.1.1 Dead Load

The dead load shall consist of the weight of the structural frame and all other materials of the building system.

#### 1.3.1.2 Collateral Loads

Collateral load of 5 pounds per square foot shall be applied to the entire structure to account for the weight of additional permanent materials other than the building system, such as sprinklers, mechanical systems, electrical systems, hung partitions, and ceilings. This allowance does not include the weight of hung equipment weighing 50 pounds or more. Equipment loads of 50 pounds or more shall be investigated and the structure (frame, purlins, girts) shall be strengthened as required. The Contractor is responsible for providing the building manufacturer the magnitude and approximate location of all concentrated loads greater than 50 pounds.

#### 1.3.1.3 Roof Live Loads

Roof live loads shall be determined and applied in accordance with MBMA-01, but shall not be less than 20 psf.

#### 1.3.1.4 Roof Snow Loads

The ground snow load shall be as shown on the contract drawings.

#### 1.3.1.5 Wind Loads

Wind pressures shall be computed and applied in accordance with MBMA-01 unless otherwise shown or directed by the Contracting Officer.

#### 1.3.1.6 NOT USED

#### 1.3.1.7 NOT USED

#### 1.3.1.8 Seismic Loads

Seismic loads shall be computed in accordance with MBMA-01 the data indicated on the drawings.

#### 1.3.1.9 NOT USED

#### 1.3.2 Foundation Requirements

Foundations shall be designed for an allowable soil bearing pressure of 2100 pounds per square foot for column footings and 1700 pounds per square foot for continuous strip footings. A minimum bottom of footing depth of 2.0 feet below finish floor elevation, a factor of safety of 1.5 for overturning, sliding and uplift, and a concrete compressive strength as specified in Section C-03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

#### 1.3.3 Framing and Structural Members

Structural steel members and their connections shall be designed in accordance with AISC-S335. Structural cold-formed steel framing members and their connections shall be designed in accordance with AISI SG-673. Aluminum structural members and their connections shall be designed in accordance with AA SAS-30. Framed openings shall be designed to structurally replace the covering and framing displaced. The allowable live load deflection of roof elements (purlins and frame) shall not exceed 1/240th of the span. Members with openings in their webs shall be designed with consideration of the additional stresses which will result due to the openings. Deflections of the steel framing above and along the side of rolling door openings shall be limited to a maximum of 1/2 of the allowable movement in the telescoping top roller of the doors to ensure proper operation of the doors.

#### 1.3.4 Exterior Covering

Except as otherwise specified, steel covering shall be designed in accordance with AISI SG-673. Aluminum covering shall be designed in accordance with the AA-01. Section modulus and moment of inertia of aluminum sheet shall be determined for actual cross section dimensions by the conventional methods for actual design stresses and by effective width concept for deflection in accordance with AA SAS-30. Maximum deflection for wall and roof panels under full dead and live and/or wind loads shall not exceed 1/180th of the span between supports. The design analysis shall establish that the roof when deflected under dead plus live or snow loads, will not result in a negative gradient. Maximum deflections shall be based on sheets continuous across two or more supports with sheets unfastened and fully free to deflect. In addition to the loads indicated above, the roof decking shall be designed for a 200 pound concentrated load at midspan on a 12 inch wide section of deck. Panels thinner than 0.03 inches are not permitted for diaphragms used to resist seismic loads. The methods for resisting lateral loads shall be cross-bracing, rigid frames, or wind columns.



#### 1.3.5 Gutters And Downspouts

Gutters and downspouts shall be designed according to the requirements of SMACNA-1013 for storms which should be exceeded only once in 5 years and with adequate provisions for thermal expansion and contraction. Supports for gutters and downspouts shall be designed for the anticipated loads.

#### 1.3.6 Louvers

Louvers shall be fixed-blade type designed for a minimum net 50% free area and shall be rainproof.

#### 1.3.7 NOT USED

#### 1.3.8 Drift Provision

Lateral deflections, or drift at the roof level of a structure in relation to the floor or slab on grade, caused by deflection of horizontal force resisting elements shall conform to MBMA-01.

#### 1.3.9 NOT USED

### 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

All MBS submittals described in this section shall be submitted at the same time a minimum of 40 days prior to the expected date of manufacture. The submittal, consisting of three major parts, shall include; 1) half size drawings, 2) a MBS "book", and 3) samples as described herein.

All half size drawings, including foundation drawings, shall be bound together with an index of drawings on a cover sheet.

The MBS "book" shall include the design analysis, small scale drawings, statements, reports, and certificates and shall be submitted complete in one three ring binder. The binder shall be sectioned as described below:

#### Section 1: Design Analysis

- a. Wind load distribution and design uplift.
- b. Framing summary of member sizes for roof, walls, and bracing.
- c. Structural analysis for roof, frames, walls, and bracing with design loads.
- d. Base plate design.
- e. Crane beam design.
- f. Narrative of the computer program.
- g. Foundation design (by contractor).
- h. Lateral drift calculations.
- i. Designer point of contact and telephone number.

#### Section 2: SSMRS (Roof System)

- a. Roof panel data and catalog cuts.
- b. Load tables and analysis.
- c. UL 90 listing information and static air pressure test reports.
- d. Details and colors.
- e. Thermal expansion calculations and details.

- f. Gutter calculations and details.
  - g. Roof penetration and curb details (If not on drawing).
- Section 3: Wall Panels
  - a. Wall panel data and catalog cuts.
  - b. Details and colors.
- Section 4: Paint Certifications
  - a. Shop painting and finishing specifications.
  - b. Certified test reports (less than one year old).
- Section 5: Sample Warranties
- Section 6: Metal Building Supplier Qualifications
  - a. AISC quality certificate.
  - b. Qualifications and experience of the supplier and installer.
  - c. Statement that MBS was designed from complete plans and specifications.
- Section 7: Erection Handbooks.
- Section 8: Mill certifications (may be submitted on delivery of MBS).

Samples described in this specification shall be labeled with a brief description of their intended use. Samples will be submitted at the same time as the half size drawings and the MBS "book" as described above.

#### SD-01 Data

Design Analysis; GA.

Design analysis as one package with the detail drawings. The design analysis signed by a Registered Professional Engineer shall include a list of the design loads, and complete calculations for the building, its components, and the foundations and floor slab. Formulas and references shall be identified. Assumptions and conclusions shall be explained, and cross-referencing shall be clear. The design analysis shall include, but not be limited to, the following wind and seismic information:

- a. Wind forces on various parts of the structure. Both positive and negative pressures shall be calculated with the controlling pressure summarized.

- b. Lateral forces due to seismic loading.

Computer programmed designs shall be accompanied by stress values and a letter of certification, signed by a Registered Professional Engineer, stating the design criteria and procedures used and attesting to the adequacy and accuracy of the design. A narrative of the computer program delineating the basic methodology shall be included in the submittal. The program output shall be annotated and supplemented with sketches to make it easier for an engineer unfamiliar with the program to verify the input and output. Critical load conditions used in the final sizing of the members shall be emphasized. Maximum lateral drift calculations shall be emphasized and compliance with 1.3.8 shall be demonstrated. The design analysis shall include the name and office phone number of the designer and checker who function as a point of contact to answer questions during the detail-drawing review.

#### SD-04 Drawings

Metal Building Systems; GA.

Detail drawings consisting of catalog cuts, design and erection drawings containing an isometric view of the roof showing the design wind uplift pressure

and dimensions of edge and corner zones; shop painting and finishing specifications, instruction manuals, manufacturer's recommended erection methods and procedures and other data as necessary to clearly describe design, material, sizes, layouts, construction details, fasteners, and erection. Manufacturer's recommended erection methods and procedures shall describe the basic sequence of assembly, temporary bracing, shoring, and related information necessary for erection of the metal building including its structural framework and components. A brief list of locations where buildings of similar design have been used shall be included with the detail drawings and shall include information regarding date of installation, name and address of owner, and how the structure is used. Detail drawings of the foundation system including the floor slab shall also be submitted. Drawing shall indicate location of expansion and control joints in the floor slab.

#### SD-08 Statements

Qualifications; FI0.

Qualifications of the manufacturer, and qualifications and experience of the building erector.

#### SD-13 Certificates

Metal Building Systems; FI0.

A Certificate from the metal building manufacturer stating that the metal building was designed from a complete set of the contract drawings and specifications and that the building furnished complies with the specified requirements.

Mill certification for structural bolts, framing steel, wall and roof covering, and wall liner panels.

#### SD-14 Samples

Each sampled shall be labeled with an explanation of its intended use.

Accessories; FI0.

One sample of each type of flashing, trim, closure, cap and similar items. Size shall be sufficient to show construction and configuration.

Roof and Wall Covering; GA.

One piece of each type and finish (exterior and interior) to be used, 250 mm 9 inches long, full width. The sample for factory color finished covering shall be accompanied by certified laboratory test reports showing that the sheets to be furnished are produced under a continuing quality control program and that a representative sample consisting of not less than 5 pieces has been tested and has met the quality standards specified for factory color finish.

Fasteners; FI0.

Two samples of each type to be used, with statement regarding intended use. If so requested, random samples of bolts, nuts, and washers as delivered to the jobsite shall be taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

Gaskets and Insulating Compounds; FI0.

Two samples of each type to be used and descriptive data.

Sealant; FI0.

One sample, approximately 1 pound, and descriptive data.

#### 1.5 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials other than framing and structural members shall be covered with weathertight coverings and kept dry. Storage accommodations for roof and wall covering shall provide good air circulation and protection from surface staining.

#### 1.6 GUARANTEE

The metal building system shall be guaranteed by the building manufacturer against water leaks arising out of or caused by ordinary wear and tear by the elements for a period of 20 years. Guarantee shall include any leaks at roof penetrations and flashings, including vents, base and counterflashing and expansion joints. Such guarantee shall start upon final acceptance of the work or the date the Government takes possession, whichever is earlier. Guarantee shall not have any monetary limits.

### PART 2 PRODUCTS

#### 2.1 BUILDING COMPONENTS

Each piece or part of the assembly shall be clearly and legibly marked to correspond with the detail drawings.

#### 2.2 FRAMING AND STRUCTURAL MEMBERS

Steel 1/8 inch or more in thickness shall conform to ASTM A 36, ASTM A 529, ASTM A 572, or ASTM A 588. Uncoated steel less than 1/8 inch in thickness shall conform to ASTM A 570, ASTM A 606, or ASTM A 607. Galvanized steel shall conform to ASTM A 446, G 90 coating designation, 0.045 inch minimum thickness. Aluminum-zinc coated steel shall conform to ASTM A 792, AZ 55 coating designation, 0.045 inch minimum thickness. Aluminum sheet shall conform to ASTM B 209, 0.032 inch minimum thickness. Aluminum structural shapes and tubes shall conform to ASTM B 221, or ASTM B 308. Structural pipe shall conform to ASTM A 53, ASTM A 252, ASTM A 500, ASTM A 501, ASTM A 618, ASTM B 221, ASTM B 241 or ASTM B 429. Holes for bolts shall be made in the shop.

#### 2.3 ROOF AND WALL COVERING

Panels shall be either steel or aluminum and shall have a factory color finish. Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope or the entire height of any unbroken wall surface. Width of sheets with overlapping configurations shall provide not less than 24 inches of coverage in place, and those with interlocking ribs shall provide not less than 12 inches of coverage in place. Design provisions shall be made for thermal expansion and contraction consistent with the type of system to be used. All sheets shall be square cut.

### 2.3.1 Roof Panels

Roof Panels are specified in Section C-07416 STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM. Roof deck assemblies shall be Class 90 as defined in UL 580.

### 2.3.2 Wall Panels

Wall panels shall have interlocking ribs for securing adjacent sheets. Wall covering shall be fastened to framework using concealed fasteners.

### 2.3.3 Steel Covering

Zinc-coated steel conforming to ASTM A 446, G 90 coating designation; aluminum-zinc alloy coated steel conforming to ASTM A 792. AZ 55 coating; or aluminum-coated steel conforming to ASTM A 463, Type 2, coating designation T2 65. Panels shall be 0.024 inch thick minimum, except that when the mid field of the roof is subject to design wind uplift pressures of 60 psf or greater or the steel covering is used as a diaphragm the entire roof system shall have a minimum thickness of 0.030 inch. Prior to shipment, mill finish panels shall be treated with a passivating chemical and oiled to inhibit the formation of oxide corrosion products. Panels that have become wet during shipment but have not started to oxidize shall be dried, retreated, and re-oiled.

### 2.3.4 Aluminum Covering

Alloy conforming to ASTM B 209, temper as required for the forming operation, minimum 0.032 inch thick.

### 2.3.5 NOT USED

### 2.3.6 Factory Color Finish

Wall and roof panels shall have a factory applied polyvinylidene fluoride finish on the exposed side. The exterior finish shall consist of a baked-on fluoropolymer enamel topcoat with an appropriate prime coat. Color shall match those used for the building constructed during Phase I of this project. A computer match of colors shall be used. The exterior coating shall be a nominal 1 mil thickness consisting of a polyvinylidene fluoride topcoat of not less than 0.7 mil dry film thickness and the paint manufacturer's recommended primer of not less than 2 mil thickness. The interior color finish shall consist of backer coat with a dry film thickness of 0.5 mil thick prime coat. The exterior color finish shall meet the test requirements specified below.

#### 2.3.6.1 Salt Spray Test

A sample of the sheets shall withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of not less than 8F, few No. 8 blisters, as determined by ASTM D 714; and a rating of 6 (3 mm (1/8 inch) max creep at scribe) as determined by ASTM D 1654.

#### 2.3.6.2 Formability Test

When subjected to testing in accordance with ASTM D 522, the coating film shall show no evidence of fracturing to the naked eye.

#### 2.3.6.3 Accelerated Weathering, Chalking Resistance and Color Change

A sample of the sheets shall be tested a minimum of 1000 hours in accordance with ASTM G 23, using a Type EH apparatus with cycles of 60 minutes radiation and 60 minutes condensing humidity. The coating shall withstand the weathering test without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with tape in accordance with ASTM D 3359, Test Method B, shall be considered as an area indicating loss of adhesion. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference ( $\Delta E$ ) units in accordance with ASTM D 2244. For sheets required to have a low gloss finish, the chalk rating shall be not less than No. 6 and the color difference shall be not greater than 7 units.

#### 2.3.6.4 Humidity Test

When subjected to a humidity cabinet in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage or corrosion.

#### 2.3.6.5 Impact Resistance

Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 equal to 1.5 times metal thickness in mils, expressed in inch pounds, with no loss of adhesions.

#### 2.3.6.6 Abrasion Resistant Test

When subjected to the falling sand test in accordance with ASTM D 968, the coating system shall withstand a minimum of 50 liters of sand before the appearance of the base metal. The term "appearance of base metal" refers to the metallic coating on steel or the aluminum base metal.

#### 2.3.6.7 NOT USED

#### 2.3.6.8 Pollution Resistance

Coating shall show no visual effects when immersion tested in a 10 percent hydrochloric acid solution for 24 hours in accordance with ASTM D 1308.

#### 2.3.7 Accessories

Flashing, trim, metal closure strips and curbs, fascia, caps, diverters, and similar metal accessories shall be not less than the minimum thickness specified for covering. Accessories shall be compatible with the system furnished. Exposed metal accessories shall be finished to match the covering building finish. Molded closure strips shall be bituminous-saturated fiber, closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the covering and shall not absorb or retain water.

#### 2.4 FASTENERS

Fasteners for steel wall and roof panels shall be zinc-coated steel, aluminum, corrosion resisting steel, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Fasteners for aluminum wall and roof panels shall be aluminum or corrosion resisting steel. Fasteners for structural connections shall provide both tensile and shear strength of not

less than 750 pounds per fastener. Fasteners for accessories shall be the manufacturer's standard. Exposed roof fasteners shall be gasketed or have gasketed washers on the exterior side of the covering to waterproof the fastener penetration. Washer material shall be compatible with the covering; have a minimum diameter of 3/8 inch for structural connections; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 1/8 inch thick. When wall covering is factory color finished, exposed wall fasteners shall be color finished or provided with plastic color caps to match the covering. Nonpenetrating fastener system using concealed clips shall be manufacturer's standard for the system provided.

#### 2.4.1 Screws

Screws shall be as recommended by the manufacturer to meet the strength design requirements of the panels.

#### 2.4.2 End-Welded Studs

Automatic end-welded studs shall be shouldered type with a shank diameter of not less than 3/16 inch and cap or nut for holding covering against the shoulder.

#### 2.4.3 Explosive Actuated Fasteners

Fasteners for use with explosive actuated tools shall have a shank diameter of not less than 0.145 inch with a shank length of not less than 1/2 inch for fastening panels to steel and not less than 1 inch for fastening panels to concrete.

#### 2.4.4 Blind Rivets

Blind rivets shall be aluminum with 3/16 inch nominal diameter shank or stainless steel with 1/8 inch nominal diameter shank. Rivets shall be threaded stem type if used for other than the fastening of trim. Rivets with hollow stems shall have closed ends.

#### 2.4.5 Bolts

Bolts shall be not less than 1/4 inch diameter, shouldered or plain shank as required, with proper nuts.

### 2.5 GUTTERS AND DOWNSPOUTS

Gutters and downspouts shall be fabricated of aluminum, zinc-coated steel or aluminum-zinc alloy coated steel and shall have manufacturer's standard factory color finish. Color shall match those used for the building constructed during Phase I of this project. A computer match of colors shall be used. Minimum uncoated thickness of materials shall be 0.018 inch for steel and 0.032 inch for aluminum. All accessories necessary for the complete installation of the gutters and downspouts shall be furnished. Accessories shall include gutter straps, downspout elbows, downspout straps and fasteners fabricated from metal compatible with the gutters and downspouts.

### 2.6 LOUVERS

Louvers shall be fabricated of aluminum, zinc-coated steel, or aluminum-zinc alloy coated steel; shall have manufacturer's standard factory color finish; and shall be furnished with bird screens. Minimum uncoated thickness of materials shall be 0.048 inch for steel and 0.064 inch for aluminum. Manually operated louvers shall be designed to be opened and closed from the operating floor.

2.7 NOT USED

2.8 NOT USED

2.9 NOT USED

2.10 NOT USED

2.11 DOORS

2.11.1 Hinged Doors

Hinged doors and frames shall conform to the requirements of Section C-08110 STEEL DOORS AND FRAMES. Exterior doors shall have top edges closed flush and sealed against water penetration. Hardware shall be as specified in Section C-08700 BUILDERS' HARDWARE.

2.11.2 NOT USED

2.11.3 NOT USED

2.12 NOT USED

2.13 NOT USED

2.14 NOT USED

2.15 SEALANT

Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubberlike consistency. Concealed sealant may be the nonhardening type.

2.16 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

2.17 NOT USED

2.18 SHOP PRIMING

Ferrous surfaces shall be cleaned of oil, grease, loose rust, loose mill scale, and other foreign substances and shop primed. Primer coating shall be in accordance with the manufacturer's standard system.

### PART 3 EXECUTION

3.1 ERECTION

3.1.1 General

Erection shall be in accordance with the approved erection instructions and drawings and with applicable provision of AISC-S335. The completed buildings shall be free of excessive noise from wind-induced vibrations under the ordinary weather conditions to be encountered at the location where the building is erected, and meet all specified design requirements. Dissimilar materials which are not compatible when contacting each other shall be insulated from each other



by means of gaskets or insulating compounds. Framing members fabricated or modified on site shall be saw or abrasive cut; bolt holes shall be drilled. On-site flame cutting of framing members, with the exception of small access holes in structural beam or column webs, shall not be permitted. Improper or mislocated drill holes shall be plugged with an oversize screw fastener and gasketed washer; however, sheets with an excess of such holes or with such holes in critical locations shall not be used. Improper or mislocated bolt holes in structural members or other misfits caused by improper fabrication or erection, shall be repaired in accordance with AISC-S303. Exposed surfaces shall be kept clean and free from sealant, metal cuttings, excess material from thermal cutting, and other foreign materials. Exposed surfaces which have been thermally cut shall be finished smooth within a tolerance of 1/8 inch. Stained, discolored or damaged sheets shall be removed from the site. Welding of steel shall conform to AWS D1.1; welding of aluminum shall conform to AA SAS-30. High-strength bolting shall conform to AISC-S329 using ASTM A 325 bolts. Concrete work is specified in Section C-03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

### 3.1.2 Framing and Structural Members

Anchor bolts shall be accurately set by template while the concrete is in a plastic state. Uniform bearing under base plates and sill members shall be provided using a nonshrinking grout when necessary. Members shall be accurately spaced to assure proper fitting of covering. Separate leveling plates under column base plates shall not be used. As erection progresses, the work shall be securely fastened to resist the dead load and wind and erection stresses. Supports for electric overhead traveling cranes shall be positioned and aligned in accordance with MHI CMAA 70.

### 3.1.3 Wall Covering and Roof Covering

Wall covering shall be applied with the longitudinal configurations in the vertical position. Standing seam roof panels shall be installed in accordance with Section C-07416 STRUCTURAL STANDING SEAM METAL ROOF (SSMR) SYSTEM. Accessories shall be fastened into framing members, except as otherwise approved. Closure strips shall be provided as indicated and where necessary to provide weathertight construction.

#### 3.1.3.1 NOT USED

#### 3.1.3.2 Concealed Fastener Wall Panels

Panels shall be fastened to framing members with concealed fastening clips or other concealed devices standard with the manufacturer. Spacing of fastening clips and fasteners shall be in accordance with the manufacturer's written instructions insofar as the maximum fastener spacings specified are not exceeded and provided such standard practice will result in a structure which will be free from water leaks and meet design requirements. Spacing of fasteners and anchor clips along the panel interlocking ribs shall not exceed 12 inches on center except when otherwise approved. Fasteners shall not puncture covering sheets except as approved for flashing, closures, and trim; exposed fasteners shall be installed in straight lines. Interlocking ribs shall be sealed according to manufacturer's recommendations. Joints at accessories shall be sealed.

#### 3.1.4 Gutters and Downspouts

Gutters and downspouts shall be rigidly attached to the building. Spacing of cleats for gutters shall be 16 inches maximum. Spacing of brackets and spacers for gutters shall be 36 inches maximum. Supports for downspouts shall be spaced according to manufacturer's recommendations.

### 3.1.5 Louvers

Louvers shall be rigidly attached to the supporting construction in a manner to assure a rain-tight installation.

### 3.1.6 Doors

Doors including frames and hardware, shall be securely anchored to the supporting construction, shall be installed plumb and true, and shall be adjusted as necessary to provide proper operation. Joints at doors shall be sealed according to manufacturer's recommendations to provide weathertight construction.

### 3.1.7 NOT USED

### 3.1.8 NOT USED

### 3.1.9 NOT USED

### 3.1.10 NOT USED

### 3.1.11 NOT USED

## 3.2 FIELD PAINTING

Immediately upon detection, abraded or corroded spots on shop-painted surfaces shall be wire brushed and touched up with the same material used for the shop coat. Shop-primed ferrous surfaces exposed on the outside of the building and all shop-primed surfaces of doors and windows shall be painted with two coats of an approved exterior enamel. Factory color finished surfaces shall be touched up as necessary with the manufacturer's recommended touch-up paint.

--END OF SECTION--

## SECTION C-13130

### PREFABRICATED SENTRY BUILDING

#### PART 1 GENERAL

##### 1.1 SUMMARY

Furnish factory fabricated, relocatable structure completely assembled including roof, and walls with openings as indicated. Self-contained environmental control system will be required for the Sentry Building. Size as indicated on drawings.

##### 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

###### SD-01 Data

Manufacturer's Catalog Data; FIO.

Provide manufacturer's catalog data describing the building system in its entirety.

###### SD-04 Drawings

Detail Drawings; FIO.

Provide manufacturer's shop drawings necessary to describe design, materials, sizes layouts, construction details and erection.

###### SD-19 Operation and Maintenance

Operation Manual; FIO.

Provide six reproducible copies of the operation manuals for the building and mechanical systems.

#### 2. DESIGN REQUIREMENTS

##### 2.1 Loadings

Buildings shall be designed for the dead load, the specified live loads, and the combinations of these loads as set forth in the MBMA publication, Metal Building Systems Manual. Reduction of load due to tributary loaded area will not be permitted. In addition to dead load, the following loads shall be included:

Vertical live load of 25 psf.  
Design wind velocity of 70 mph.  
Auxiliary loads of Seismic Zone 2A.

#### 3. MATERIALS

3.1 Buildings shall be of galvanized steel, aluminized steel or aluminum construction.

3.2 Structural members to be extruded aluminum angles, channels and tee sections of structural alloy 6063T6, natural satin anodized alloy 6063T6, with ribbed pattern exterior surfaces, or 14 gauge galvanized steel tubing.

3.3 Wall panels interior finish shall be 18 gauge galvanized steel or aluminum panels and trim bonded to rigid insulation with 14 gauge galvanized steel or aluminum diamond embossed exterior finish sheet permanently laminated to insulation. To provide a maximum total "U" value of .08 across completed wall assembly. Total exterior and interior to be factory painted. Colors shall be equivalent to a computer match of the colors indicated.

3.4 Doors to be of anodized aluminum tubular construction, designed for heavy-duty industrial usage and half-glazed with clear tempered safety glass. Bottom portion to include panel with finish to match interior and exterior of building walls.

3.4.1 Swing doors to be prehung with butt hinges, key-in-knob lockset and closer.

3.5 Windows shall have anodized aluminum frames and insert frames and shall industrial quality. Windows to be single-hung factory glazed with 1/2-inch insulating glazing. Windows to include screens and inside locking device.

3.6 Ceiling panel shall be metal finish matching wall panels and shall be bonded to rigid insulation to provide an "R" value of 33.

3.7 The building shall provide a waterproof insulating fit when fastened to the concrete base.

3.8 Fasteners used to manufacture and assemble building shall be corrosion-proof type and shall permit on-site replacement of damaged components.

3.9 Roof shall be galvanized steel, aluminized steel, or aluminum ribbed roof with fascia trim, soffit, and integral self-contained gutter. Roof overhang shall be indicated on drawings.

3.10 Each unit shall be furnished complete with factory installed HVAC unit as indicated on drawings.

3.11 Concrete and foundation base size shall be coordinated with building manufacturer.

#### 4. INSTALLATION

4.1 Unit shall be shipped complete and fully assembled. Units shall be installed where indicated on drawings and in accordance with manufacturer's recommendations.

4.2 Concrete shall be installed per specifications SECTION 03300 CONCRETE FOR BUILDING CONSTRUCTION. Slab shall have steel trowel finish with hardener. Provide continuous perimeter insulation with a minimum "R" value of 7.

-- End of Section --

## SECTION C-13814

### BUILDING PREPARATION FOR ENERGY MONITORING AND CONTROL SYSTEMS (EMCS)

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1 (1988) Code for Electricity Metering

##### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME-18 (1971; Int. Supple 19.5 - 1972; Errata 1974)  
Fluid Meters, Their Theory and Application

##### INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C57.13 (1993) Instrument Transformers

##### NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1991) Enclosures for Electrical  
Equipment (1000 Volts Maximum)

NEMA ICS 1 (1993) Industrial Controls and Systems

##### 1.2 GENERAL REQUIREMENTS

###### 1.2.1 Preparation of Building for Interface

The Contractor shall provide all services, materials, and equipment necessary to prepare the building for interface to a future EMCS.

###### 1.2.2 Environmental Conditions

All equipment shall be rated for continuous operation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified or normally encountered at the installed location.

##### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment and Performance; GA.

Six copies of the hardware and maintenance data, in manual format, bound in hardback, loose-leaf binders, within 30 days after completing the site testing. The contents of each manual shall be identified on the cover. The manuals shall include the names, addresses, and telephone numbers of each subcontractor

installing equipment and systems, and of the nearest service representatives for each item of equipment and each system. The manuals shall have a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies, to be submitted after completion of the site test, shall include all modifications made during installation, checkout, and acceptance.

Hardware data, shall describe all equipment provided, including:

- a. General description and specifications.
- b. Installation and checkout procedures.
- c. Electrical schematics and layout drawings.
- d. Alignment and calibration procedures.
- e. Manufacturer's repair parts list indicating sources of supply, and National Stock Number when obtainable from the manufacturer.
- f. Interface definition.

The maintenance data, shall include descriptions of maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

#### SD-04 Drawings

Equipment and Material; GA.

Detail drawings consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Drawings shall contain complete wiring, routing, and schematic diagrams. Drawings shall show proposed layout and installation of all equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

#### SD-08 Statements

Test Plan; GA.

Six copies of test plan and test procedure. Six copies of test report that documents the test results, in booklet form. Test plan documents for the test, 120 days prior to the test. The test plan shall define all the tests required to ensure that the equipment meets technical and performance specifications. The test plan shall define milestones for the test exercises and shall identify the capabilities and functions to be tested.

Test Procedure; GA.

Test procedure documents, 60 days prior to the test. Test procedures shall be developed from the test plans and design documentation. The procedures shall consist of detailed instructions for test setup, execution, and evaluation of test results. The procedures shall explain and shall detail, step by step, actions and expected results to demonstrate the requirements of this specification and the methods for simulating the necessary conditions of operation to demonstrate performance of the equipment. All test equipment to be used shall be furnished by the Contractor.

## SD-09 Reports

Site Testing; GA.

Test report, within 15 days after completion of the test. The test report shall be used to document results of the test.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Units of the same type of equipment shall be products of a single manufacturer.

### 2.2 ENCLOSURES

Enclosures shall conform to the requirements of NEMA 250 for the types specified. Finish color shall be the manufacturer's standard, unless otherwise indicated. Damaged surfaces shall be repaired and refinished using original type finish. Enclosures installed indoors shall be Type 12, or as shown. Equipment installed outdoors shall be housed in a Type 4 enclosure, unless otherwise shown.

### 2.3 NAMEPLATES

Laminated plastic nameplates shall be provided for all equipment furnished. Each nameplate shall identify the function, such as "mixed air controller" or "cold deck temperature sensor." Laminated plastic shall be 1/8-inch thick, white with black center core. Nameplates shall be a minimum of 1 inch by 3 inches, with minimum 1/4-inch high engraved block lettering. Nameplates for devices smaller than 1-inch by 3-inches shall be attached by a nonferrous metal chain. All other nameplates shall be attached to the equipment.

### 2.4 INSTRUMENTATION AND CONTROL (I&C) DIAGRAMS

Framed mylar drawings in laminated plastic shall be provided. Drawings shall show complete I&C diagrams for all equipment furnished and interfaces to all existing equipment, at each respective equipment location. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system manually shall be prepared in typed form, framed as specified for the I&C diagrams and posted beside the diagrams. Proposed diagrams, instructions, and other sheets shall be submitted prior to posting. The instructions shall be posted after completion of the Contractor's site testing. Provide a mylar reproducible of each I&C diagram in addition to the posted copy.

### 2.5 DATA TERMINAL CABINET (DTC)

Data terminal cabinet shall be provided for each mechanical room as an interface to the data environment (DE) instrumentation and controls. No instrumentation and control devices shall be located within the DTC.

#### 2.5.1 Enclosure

The DTC shall be a separate metallic enclosure. The DTC shall be sized to accommodate the number of functions required by the control and monitoring devices as shown plus 25 percent expansion for each type of function provided.

#### 2.5.2 Groupings

The DTC shall be divided into analog and digital groupings, each with separate sensor and control signal wiring raceways.

### 2.5.3 Terminal Strips

The DTC shall be provided with double sided screw type terminal strips. One side of the terminal strip shall be used for termination of field wiring from instrumentation and controls. The other side shall be used to connect the DTC to the future FID or MUX. Terminal strips shall have individual terminal identification numbers.

### 2.5.4 Power

A 120-Vac, 15-A, 60 Hz duplex outlet shall be provided within 6 feet of each DTC.

## 2.6 INSTRUMENTATION AND CONTROL

### 2.6.1 Temperature Instruments

#### 2.6.1.1 Resistor Temperature Detector (RTD)

RTDs shall be platinum with an accuracy of plus or minus 0.1 percent at 32 degrees F and shall be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper. Each RTD shall be furnished with an RTD transmitter specified and mounted integrally, unless otherwise shown.

#### 2.6.1.2 Resistor Temperature Detector (RTD) Transmitters

The RTD transmitter shall be selected to match the resistance range of the platinum RTD. The transmitter shall produce a linear 4 to 20 mA<sub>dc</sub> output corresponding to the required temperature span. The output error shall not exceed 0.1 percent of calibrated span. The transmitter shall include offset and span adjustments unless the RTD element is integral to the transmitter and system calibration is provided.

#### 2.6.1.3 Continuous Averaging RTDs

Continuous averaging RTDs shall have an accuracy of plus or minus 1.0 degree F at the reference temperature, and shall be of sufficient length to ensure that the resistance represents an average over the cross section in which it is installed. The sensor shall have a bendable copper sheath. Each averaging RTD shall be furnished with an RTD transmitter selected to match the resistance range of the averaging RTD. The transmitter shall produce a linear 4 to 20 mA<sub>dc</sub> output corresponding to the required temperature span. The output error of the transmitter shall not exceed 0.1 percent of the calibrated span. The transmitter shall include offset and span adjustments.

#### 2.6.1.4 Temperature Switches

Temperature switches shall have a repetitive accuracy of plus or minus 1 percent of the operating ranges shown. Switch actuation shall be adjustable over the operating temperature range. The switch shall have a snap-action Form C contact rated for the application.

#### 2.6.1.5 Thermowells

Thermowells shall be monel, brass, or copper for use in copper water lines, wrought iron for measuring flue gases, and series 300 stainless steel for all other applications. The thermowell shall include a connection box, sized to accommodate the temperature transmitter.



2.6.1.6 NOT USED

2.6.2 NOT USED

2.6.3 Pressure Instruments

2.6.3.1 Pressure Transducers

Pressure transducers shall withstand up to 150 percent of rated pressure, with an accuracy of plus or minus 1 percent of full scale. The sensing element shall be either capsule, diaphragm, bellows, bourdon tube, or solid state. A transmitter located at the transducer shall be provided to convert the sensing element output to a linear 4 to 20 mA<sub>dc</sub> output corresponding to the required pressure span. The output error shall not exceed 0.1 percent of calibrated span. The transmitter shall include offset and span adjustments.

2.6.3.2 Pressure Switches

Pressure switches shall have a repetitive accuracy of plus or minus 5 percent of their operating range and shall withstand up to 150 percent of rated pressure. Sensors shall be diaphragm or bourdon tube. Switch actuation shall be adjustable over the operating pressure range. Switch shall have a snap-action Form C contact rated for the application. Gauge pressure switches shall have an adjustable differential setting.

2.6.4 NOT USED

2.6.5 NOT USED

2.6.6 Output Devices

2.6.6.1 Control Relays

Control relay contacts shall be rated for the application, with a minimum of 2 sets of Form C contacts enclosed in a dust-proof enclosure. Relays shall be rated for a minimum life of one million mechanical operations. Operating time shall be 20 milliseconds or less, with release time of 10 milliseconds or less. Relays shall be equipped with coil transient suppression devices to limit transients to 150 percent of rated coil voltage.

2.6.6.2 NOT USED

2.6.6.3 Latching Relays

Latching relay contacts shall be rated for the application with a minimum of 2 sets of Form C contacts enclosed in a dust-proof enclosure. Relays shall be rated for a minimum life of one million mechanical operations. Operating time shall be 20 milliseconds or less, with release time of 10 milliseconds or less. Relays shall be equipped with coil transient suppression devices to limit transients to 150 percent of rated coil voltage.

2.6.6.4 Reed Relays

Reed relays shall be encapsulated in a container housed in a plastic, epoxy, or metal case. Contacts shall be rated for the application. Operating and release times shall be 1 millisecond or less. Relays shall be rated for a minimum life of 10 million mechanical operations and shall be equipped with coil transient suppression devices to limit transients to 150 percent of rated coil voltage.

#### 2.6.6.5 Contactors

Contactors shall be of the single coil, electrically operated, mechanically held type. Positive locking shall be obtained without the use of hooks, latches, or semipermanent magnets. Contacts shall be double-break silver-to-silver type protected by arcing contacts where necessary. Number of contacts and ratings shall be selected for the application. Operating and release times shall be 100 milliseconds or less. Contactors shall be equipped with coil transient suppression devices to limit transients to 150 percent of rated coil voltage.

#### 2.6.6.6 Solid State Relays

Input-output isolation shall be greater than 1000 megohms with a breakdown voltage of 1500 volts root mean square or greater at 60 Hz. Relays shall be rated for a minimum life of 10 million operations. The ambient temperature range shall be at least minus 20 to plus 140 degrees F. Input impedance shall not be less than 500 ohms. Relays shall be rated for the application. Operating and release times shall be 1 millisecond or less. Transients shall be limited to 150 percent of control voltage. Solid state relays shall not be used on inductive loads which are switched on-off.

#### 2.6.6.7 NOT USED

#### 2.6.6.8 Single Input Control Point Adjustment (CPA) Controller

Single input CPA controllers shall permit changing of control points remotely by varying the CPA port value. CPA shall be plus or minus 10 percent of primary sensor span. Controllers shall operate from electronic sensors as shown. Controllers shall be complete with adjustable setpoint, adjustable gain (proportional band), and shall be field selectable for direct or reverse action. All controller inputs and outputs shall be provided with internal or external gauges or meters for calibration of input and output signals.

#### 2.6.6.9 NOT USED

#### 2.6.6.10 NOT USED

#### 2.6.6.11 NOT USED

#### 2.6.6.12 NOT USED

#### 2.6.7 Position Sensors

##### 2.6.7.1 End (Limit) Switches

Limit switches shall be of the sealed or enclosed type as required for the application. Contacts shall be snap-action Form C rated for the application.

##### 2.6.7.2 NOT USED

#### 2.6.8 Key Operated Switches

Hand-off-automatic (HOA), off-automatic, and all similar-use switches shall be key operated with all switches keyed alike. All switches shall be rated for a minimum of 600 Vac, 5-A, and shall be mounted in an enclosure as specified or shown. An auxiliary set of contacts rated for at least 120 Vac, 1 ampere shall be provided with each switch.

## 2.7 WIRE AND CABLE

The Contractor shall provide all wire and cable from the sensors and control devices in the DE to the DTCs.

### 2.7.1 Control Wiring

#### 2.7.1.1 Digital Functions

Control wiring for digital functions shall be No. 18 AWG minimum with 600-volt insulation. Multiconductor wire shall have an outer jacket of Polyvinyl Chloride (PVC).

#### 2.7.1.2 Analog Functions

Control wiring for analog functions shall be No. 18 AWG minimum with 600-volt insulation, twisted and shielded, 2-, 3-, or 4-wire to match analog function hardware. Multiconductor wire shall have an outer jacket of PVC.

### 2.7.2 Sensor Wiring

Sensor wiring shall be No. 20 AWG minimum twisted and shielded, 2-, 3-, 4-wire to match analog function hardware. Multiconductor wire shall have an outer jacket of PVC.

### 2.7.3 Class 2 Low Energy Conductors

The conductor types and sizes specified for digital and analog functions shall take precedence over any requirements for Class 2 low energy remote control and signal circuit conductors specified elsewhere.

## 2.8 RACEWAY SYSTEMS

Raceway systems from the sensors and control devices in the DE to the DTCs shall be provided by the Contractor.

## PART 3 EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS

The Contractor shall install all components and appurtenances in accordance with the manufacturer's instructions and as shown or specified. All necessary interconnections, services, and adjustments required to prepare the building for interface to an EMCS shall be furnished. All wiring, including low voltage wiring, shall be installed in metallic raceways. All other electrical work shall be in accordance with Section C-16415 and as shown. Instrumentation grounding as necessary to preclude ground loops and noise from adversely affecting equipment operations shall be installed.

### 3.2 I/O SUMMARY TABLES

I/O Summary Tables shall be used in conjunction with the drawings to identify the hardware required for each building and system.

### 3.3 EQUIPMENT INSTALLATION

#### 3.3.1 Temperature Instruments

##### 3.3.1.1 Resistor Temperature Detector (RTD)

When the RTD is installed in pipes or is susceptible to corrosion and vibration, the RTD shall be installed in a thermowell. RTDs which are attached to surfaces shall be clamped or bonded in place. The surface shall be thoroughly cleaned, degreased, and after RTD installation, shall be insulated from ambient temperature effects. RTDs used for space temperature sensing shall include a housing suitable for wall mounting. RTDs used for OA sensing shall have an instrument shelter to minimize solar effects, and shall be mounted to minimize building effects. RTD assemblies shall be readily accessible and installed in a manner as to allow easy replacement.

#### 3.3.1.2 Temperature Switches

Temperature switches shall be installed as specified for RTDs. Temperature switches shall be adjusted to the proper setpoint and shall be verified by calibration. Switch contact ratings and duty shall be selected in accordance with NEMA ICS 1.

#### 3.3.2 NOT USED

#### 3.3.3 Pressure Instruments

##### 3.3.3.1 Pressure Sensors

Pressure sensors (all types) installed on liquid lines shall have drains. Pressure sensors installed on steam lines shall have drains and siphons. All pressure sensors shall have valves for isolation, venting, and taps for calibration. Pressure sensors shall be verified by calibration. Differential pressure sensors shall have nulling valves.

##### 3.3.3.2 Pressure Switches

Pressure switches (all types) installed on liquid lines shall have drains. All pressure switches in steam lines shall have valves for isolation, venting, and taps for calibration. Pressure switches shall be adjusted to the proper setpoint, and shall be verified by calibration. Pressure switches shall be mounted higher than the process connection. Differential pressure switches shall have nulling valves. Switch contact ratings and duty shall be selected in accordance with NEMA ICS 1.

#### 3.3.4 NOT USED

#### 3.3.5 NOT USED

#### 3.3.6 Output Devices

##### 3.3.6.1 Relays and Contactors

Relays and contactors shall be installed in new cabinets.

##### 3.3.6.2 NOT USED

##### 3.3.6.3 Controllers

Controllers shall be installed in new control cabinets or as shown.

##### 3.3.6.4 NOT USED

##### 3.3.7 Position Sensors

#### 3.3.7.1 End (Limit) Switch

Limit switch type and mounting shall be properly suited for the application to provide reliable switch operation.

#### 3.3.7.2 NOT USED

#### 3.3.8 NOT USED

#### 3.3.9 Enclosures

All enclosure penetrations shall be from the bottom and shall be sealed to preclude entry of water using a silicone rubber sealant.

#### 3.4 SITE TESTING

Site testing and adjustment of all equipment shall be performed in accordance with approved test procedures. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all site testing. Test reports shall be submitted as specified.

-- End of Section --

SECTION C-14630

OVERHEAD ELECTRIC CRANES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)

AGMA 390.03a	(1980; Errata 19983) Gear Handbook Gear Classification, Materials and Measuring Methods for Bevel, Hypoid, Fine Pitch Wormgearing and Racks Only as Unassembled Gears
AGMA 2000-A	(1988; Errata Jan 1989) Gear Classification and Inspection Handbook
AGMA 2001-B	(1995) Fundamental Rating Factors & Calculation Methods for Involute Spur and Helical Gear Teeth
AGMA 6010-E	(1988; Errata Nov 91) Standard for Spur, Helical, Herringbone and Bevel Enclosed Drives
AGMA 6019-E	(1989) Gearmotors Using Spur, Helical, Herringbone, Straight Bevel, or Spiral Bevel Gears

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC ASD MAN, Vol I	(1993) Manual of Steel Construction
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 159	(1983; R 1993) Automotive Gray Iron Castings
ASTM A 325	(1994) Structural Bolts, Steel Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 668	(1995) Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM B 438	(1995a) Sintered Bronze Bearings (Oil-Impregnated)
ASTM B 439	(1995) Iron-Base Sintered Bearings (Oil-Impregnated)
ASTM B 612	(1991) Iron Bronze Sintered Bearings (Oil-Impregnated)

ASTM B 633 (1985; R 1994) Electrodeposited Coatings of Zinc on Iron and Steel

ASTM E 125 (1963; R 1993) Standard Reference Photographs for Magnetic Particle Indications on Ferrous Castings (R 1985)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B30.2 (1990; B30.2a; B30.2b; B 30.2c; B30.2d) Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)

ASME B30.16 (1993; B30.16a; B30.16b; B30.16c) Overhead Hoist (Underhung)

ASME B30.17 (1992; Errata; Sep 1993; B30.17a; B30.17b; B30.17c) Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)

ASME HST-4M (1991) Performance Standard for Overhead Electric Wire Rope Hoists

AMERICAN WELDING SOCIETY (AWS)

AWS D14.1 (1985) Welding of Industrial and Mill Cranes and Other Material Handling Equipment

MATERIAL HANDLING INSTITUTE (MHI)

MHI CMAA 70 (1994) Electric Overhead Traveling Cranes

MHI CMAA 74 (1994) Top Running & Under Running Single Girder Electric Overhead Traveling Cranes Utilizing Under Running Trolley Hoist

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2 (1993) Industrial Control and Systems, Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 volts AC or 750 Volts DC

NEMA ICS 6 (1993) Industrial Control and Systems, Enclosures

NEMA MG 1 (1993; Rev 1; Rev 2) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 50 (1995; Rev Oct 1996) Enclosures for Electrical Equipment

UL 489 (1996) Molded-Case Circuit Breakers and Circuit-Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

UL 943 (1993; Rev thru Sep 1996) Ground-Fault Circuit Interrupters

UL 1449 (1985; Errata Apr 1986) Transient Voltage Surge Suppressors

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

### SD-01 Data

Overhead Crane System; FIO.

A complete list of equipment and materials, including manufacturer's descriptive data and technical literature, performance charts and curves, catalog cuts, and installation instructions.

Spare Parts; FIO.

Spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than three months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

### SD-04 Drawings

Overhead Crane System; GA.

Detail drawings containing complete wiring and schematic diagrams. Diagrams shall indicate each numbered wire, where wire initiates, where wire terminates, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation. Drawings must show compliance with crane system envelope as described on the drawings.

### SD-06 Instructions

Framed Instructions FIO.

Diagrams, instructions and safety requirements.

### SD-09 Reports

Acceptance Testing; FIO.

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. The report shall include the information as required by paragraph ACCEPTANCE TESTING.

### SD-18 Records

Hooks; FIO.

Hook material and any heat treatment performed, stamped on the hook shank or documented in certification papers furnished with the hooks. Crane test data



recorded on appropriate test record forms suitable for retention for the life of the crane.

#### SD-19 Operation and Maintenance Manuals

Overhead Crane System; GA.

Six copies of operation and six copies of maintenance manuals for the equipment furnished. One complete set prior to performance testing and the remainder upon acceptance. Operation manuals shall detail the step-by-step procedures required for system startup, operation and shutdown. Operation manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and basic operating features. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed. Operation and maintenance manuals shall be approved prior to the field training course.

### 1.3 QUALIFICATION

Electric overhead cranes shall be designed and manufactured by a company with a minimum of 10 years of specialized experience in designing and manufacturing the type of overhead crane required to meet requirements of the Contract Documents.

### 1.4 TESTING AND INSPECTIONS

#### 1.4.1 Pre-Delivery Inspections

Contractor shall be responsible for performance of quality control inspections, testing and documentation of steel castings, hook assembly and nuclear safety as follows.

#### 1.4.2 Inspection of Steel Castings

Load-carrying steel castings shall be visually inspected and tested using the magnetic-particle inspection method. Allowable degree of discontinuities shall be referenced to ASTM E 125, and shall be related to service loads and stresses, critical configuration, location and type. Methods of repairing the discontinuities shall be subject to review by the Contracting Officer.

#### 1.4.3 Inspection of Hook Assembly

Hook and nut shall be inspected by a magnetic-particle type inspection or X-rayed prior to delivery. Documentation of hook inspection shall be furnished to Contracting Officer at the field operational testing. As part of the acceptance standard, linear indications will not be allowed. Welding repairs of hook will not be permitted. A hook showing linear indications, damage or deformation will not be accepted, and shall be replaced.

#### 1.4.4 NOT USED

### 1.5 DESIGN CRITERIA

Cranes shall operate in the given spaces and shall match the runway dimensions indicated. Hook coverage, hook vertical travel, clear hook height, lifting capacity, and load test weight shall not be less than that indicated.

#### 1.5.1 General

The hoisting equipment shall include the following:

Number of cranes; two, one each located in building names; B & C with the number of tons; 7-1/2, electric overhead traveling crane.

#### 1.5.2 Classification

Crane shall be designed and constructed to MHI CMAA 70 Class C service, requirements for operation in non-hazardous environment with hoist in accordance with ASME HST-4M.

#### 1.5.3 Rated Capacity and Speeds

Rated capacity of crane shall be 7-1/2 tons. Lower load block or assembly of hook, swivel bearing sheaves, pins and frame suspended by the hoisting ropes shall not be considered part of the rated capacity. Rated speeds (in feet per minute) for the hoist, bridge and trolley at the rated load shall be as follows:

Rated Speeds (fpm)		
Description	Minimum	Maximum
Main Hoist	7	22
Trolley	22	65
Bridge	25	75

#### 1.5.4 Seismic Criteria

Cranes shall be designed to accommodate the criteria specified in Section C-13080 SEISMIC PROTECTION FOR MECHANICAL, ELECTRICAL EQUIPMENT.

#### 1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

#### 1.7 FIELD MEASUREMENTS

Before performing any work, Contractor shall become familiar with all details of the work, verify all dimensions in the field, and submit a letter describing the results of this verification including discrepancies to the Contracting Officer and crane manufacture.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

##### 2.1.1 General

Materials and equipment shall be standard products of manufacturers regularly engaged in the fabrication of complete and totally functional cranes including necessary ancillary equipment.

### 2.1.2 Nameplates

Nameplates shall be secured to each major component of equipment with the manufacturer's name, address, type or style, model or catalog number, and serial number. Two bridge identification plates shall be provided, one for each side of bridge. Identified plates shall be noncorrosive metal with letters which are easily read from the floor, showing a separate number such as BC-1, BC-2, for each bridge crane.

### 2.1.3 Use of Asbestos Products

Materials and products required for designing and manufacturing cranes shall not contain asbestos.

### 2.1.4 Capacity Plates

Two capacity plates indicating the crane capacity in tons are required, one secured to each side of bridge. Each capacity plate shall be fabricated of a steel backing plate and exterior quality/fade-resistant stick-on labels with letters large enough to be easily read from the floor. Capacity plates shall be placed in a location visible to pendant operator's position after the crane has been installed.

### 2.1.5 Safety Warnings

Readable warning labels shall be affixed to each lift block or control pendant in a readable position in accordance with ASME B30.16, ASME B30.2 and ASME B30.17. The word "WARNING" or other legend shall be designed to bring the label to the attention of the operator. Warning labels shall be durable type and display the following information concerning safe-operating procedures: Cautionary language against lifting more than the rated load; operating the hoist when the hook is not centered under the hoist; operating hoist with twisted, kinked or damaged rope; operating damaged or malfunctioning hoist; operating a rope hoist with a rope that is not properly seated in its hoist drum groove; lifting people; lifting loads over people; and removing or obscuring the warning label.

#### 2.1.5.1 Directional Arrows

To avoid operation of crane in the wrong direction, the words "FORWARD" and "REVERSE" and accompanying directional arrows shall be affixed in a location on the trolley and bridge which are visible and readable to the operator from pendant station. The words "FORWARD" and "REVERSE" shall agree with the markings on control pendant. Directional arrows shall not be indicated on control pendant.

## 2.2 STRUCTURAL MATERIALS

### 2.2.1 Bolts, Nuts and Washers

High-strength bolted connections shall utilize SAE Grade 5 bolts with corresponding lockwashers, nuts, etc., conforming to requirements of AISC ASD MAN, Vol I bolts. Bolts, nuts and washers shall conform to ASTM A 325 bolts. Galvanized bolts are not acceptable.

### 2.2.2 Bridge Girders

Bridge girders shall be welded structural steel box sections.

### 2.2.3 NOT USED

#### 2.2.4 End Ties and Bridge Girder End Connections

Welded steel box sections shall be used for end ties, full depth diaphragms shall be provided at girder connections and jacking points. Horizontal gusset plates shall be provided at the elevation of top and bottom end tie flanges for connection to girder ends. End connections shall be made with high-strength bolts. Body-bound bolts fitted in drilled and reamed holes shall be used to maintain the crane square.

#### 2.2.5 Bridge End Trucks

End trucks shall be the rotating or fixed axle type fabricated of structural tubes or from structural steel to provide a rigid box section structure. Jacking pads shall be provided for removal of wheel assemblies.

#### 2.2.7 Stops and Bumpers

Crane runways and bridge girders shall be fitted with structural steel end stops. Bridge end trucks and trolley frames shall be fitted with shock-absorbing, spring or hydraulic type bumpers capable of decelerating and stopping the bridge and/or trolley within the limits stated by OSHA and MHI CMAA. Trolley end stops shall be of sufficient strength to withstand the impact of a fully loaded trolley moving at 50 percent of maximum rated travel speed. Bridge bumper stops shall be provided as specified in Section C-05120 STRUCTURAL STEEL.

#### 2.2.8 Footwalks

The location and construction of footwalks shall be in accordance with OSHA and ANSI B30.2. Partial footwalks shall be provided for maintenance access to bridge and trolley drives and electrical equipment. Footwalks shall be safety tread (raised pattern).

#### 2.2.9 Runway Rails

The runway rail size and anchorage to crane beams shall be as recommended by crane manufacturer.

#### 2.2.10 NOT USED

#### 2.2.11 NOT USED

### 2.3 MECHANICAL EQUIPMENT

#### 2.3.1 Drives

##### 2.3.1.1 Bridge Drives

Bridge drives shall be A-4 drive arrangement as specified in MHI CMAA 70 or MHI CMAA 74. Bridge drive shall consist of a single electric motor mechanically connected through gear reduction and drive shafts to the drive wheels or separate drive motors at each end of bridge. Acceleration and deceleration shall meet the requirements specified in this section. Gears shall conform to applicable AGMA standards. Gear reducers shall be oil tight and fully enclosed with pressure or splash type lubrication. Bridge-travel limit-switches are optional.

#### 2.3.1.2 Trolley Drives

Trolley shall be complete with a drive arrangement with a minimum of two wheels driven by an integral electric motor. Drive mechanism shall run in totally enclosed oil bath. Limit switches are optional for drive mechanism. Acceleration and deceleration controls shall meet requirements specified in this section.

#### 2.3.1.3 NOT USED

#### 2.3.2 Load Blocks

##### 2.3.2.1 Main and Auxiliary Hoist Load Blocks

Load blocks shall be of welded steel construction. Load blocks shall be provided with hot-rolled or forged steel fixed crosshead separate from the sheave pin with swivel mounting for forged steel hook. Each lubrication fitting for sheave pins shall be an independent type recessed within the sheave pin or adequately guarded to prevent damage. The pitch diameter of the sheaves shall be not less than 16 times the rope diameter. Sheaves shall be supported by roller type bearings on steel sheave pins. Provisions for external lubrication shall be provided to allow pressure relief and purging of old grease. Sheave blocks shall be constructed to provide maximum personnel safety and to prevent the hoist rope from leaving the sheaves under normal operating condition.

##### 2.3.2.2 Hook Assembly

Hooks shall be single barbed and shall be made of forged steel complying with ASTM A 668. Hook dimensions shall be as shown. Hooks shall be fitted with safety latches designed to preclude inadvertent displacement of slings from the hook saddle. Painting or welding shall not be performed on the hook. Hook nut shall be secured with a removable type set screw or other similar fastener, but shall not be welded. Hooks shall be designed and commercially rated with safety factors in accordance with MHI CMAA. The hook shall be free to rotate through 360 degrees when supporting the rated load.

#### 2.3.3 Hoisting Ropes

Hoisting ropes shall be regular lay, preformed, uncoated, improved plow steel, 6 by 37 construction, with independent wire rope core. Ropes shall be suited to meet the service requirements. Rope socketing or U-bolt clip connections shall be made in accordance with clip or rope manufacturer's recommendation, and shall be equal to or greater than the rope strength. Hoisting ropes shall be the rated capacity load plus the load block weight divided by the number of rope parts, and shall not exceed 20 percent of the certified breaking strength of rope. Hoisting ropes shall be secured to hoist drum so that no less than 2 wraps of rope remain at each anchorage of hoist drum at the extreme low position (limit switch stop).

#### 2.3.4 Sheaves

Sheaves shall be of cast, forged, rolled, or welded structural steel. Sheave grooves shall be accurately machined, smoothly finished and free of surface defects.

#### 2.3.5 Hoist Drums

Hoist drums shall be of welded rolled structural steel, cast steel, or seamless steel pipe. Diameter of drum shall be not less than 24 times the diameter of hoist cable. Drums shall be machined and provided with right-hand and left-hand grooves to take the full run of cable for the required lift without overlapping,

plus a minimum of 2 full wraps of cable when load is on floor. At least 1 groove shall remain unused when hook is at the highest position. Drum grooves shall be cut from solid stock and have sufficient depth for size of cable required. Drum flanges shall be guarded so that the cable cannot wedge between drum flange and hoist frame.

#### 2.3.6 Gearing

Gearing shall be of the enclosed gear reducers type. Gears and pinions shall be spur, helical, or herringbone type only, and shall be forged, cast or rolled steel; open-type gearing is not acceptable. Gears and pinions shall have adequate strength and durability for the crane service class and shall be manufactured to AGMA 2001-B Quality Class 6 or better precision per AGMA 390.03a or AGMA 2000-A as applicable.

##### 2.3.6.1 Gear Reducers

Gear reducers shall be standard items of manufacturers regularly engaged in the design and manufacture of gear reducers for Class D and G cranes or shall be integral components of standard hoists or hoist/trolley units of manufacturers regularly engaged in the design and manufacture of hoists or hoist/trolley units for Class A, B or C cranes. Gear reducers shall be designed, manufactured and rated in accordance with AGMA 6010-E, AGMA 6019-E (for trolley drives only), as applicable. Except for final reduction, the gear reduction units shall be fully enclosed in oil-tight housing. Gearing shall be designed to AGMA standards and shall operate in an oil bath. Operation shall be smooth and quiet.

#### 2.3.7 Brakes

Brakes shall be of the shoe or disc type with thermal capacity suitable for class and service specified in this section. Shoe and disc brakes shall be spring-set and electrically-released by a continuously rated direct acting magnet. Brakes shall be self-aligning and provide for easy adjustment for torque setting and lining wear. Brake lining material shall be asbestos free. Brake wheels shall be cast iron conforming to ASTM A 159 or shall be the manufacturer's standard high-strength ductile cast-iron, provided that the material exhibits wear characteristics in the form of powdered wear particles and is resistant to heat-checking. Disc brakes shall be totally enclosed and have multiple discs with stationary releasing magnets. Brake torque shall be easily adjustable over a 2:1 torque range.

##### 2.3.7.1 Hoist Holding Brakes

Each hoist shall be equipped with at least 1 holding brake. Holding brake shall be disc or shoe design, applied to one of the following: motor shaft or gear reducer shaft or rope drum. Braking system shall be designed to have zero hook lowering motion when a raise motion is initiated. Primary brake shall be a spring-set, electrically-released, disc or shoe type brake. Brake shall have a minimum torque rating of 150 percent of motor torque. Brake shall be capable of holding the rated load with zero hook drift. Primary brake shall be automatically set when controls are released or when power is interrupted. Provisions shall be made to facilitate easy brake adjustment. Hoists shall be furnished with mechanical-control braking or a power-control braking system. Typical power means include dynamic lowering, eddy-current braking, counter-torque, regenerative braking, variable frequency, and adjustable or variable voltage.

#### 2.3.7.2 Hoist Control Brake

Each hoist shall be equipped with an integral mechanical load brake of the "Weston" type or multiple-disc type. Multiple disc-type brake shall be provided with external adjustment for wear.

#### 2.3.7.3 Trolley Brake

Trolley braking system shall be provided with spring-applied and electrically-released shoe brakes or disc brakes. Braking system shall be automatically set when controls are released or power is interrupted. Provisions shall be made to facilitate easy brake adjustment. Brakes shall have a torque rating of at least 50 percent of trolley drive motor rated torque.

#### 2.3.7.4 Bridge Brakes

Bridge braking system shall be provided with a spring-applied and electrically-released single shoe or disc brake for each bridge drive motor. Braking system shall be automatically set when controls are released or power is interrupted. Provisions shall be made to facilitate easy brake adjustment. Brakes shall have a torque rating of at least 50 percent of bridge drive motor rated torque.

#### 2.3.8 Wheels

Wheels shall be manufactured of rolled or forged steel. Wheel treads and flanges shall be rim toughened to between 320 and 370 Brinell hardness number. Bridge and trolley wheels shall be double-flanged. Trolley wheels shall have straight treads. Bridge wheels shall have straight treads. Wheels shall be equipped with self-aligning double-row spherical roller-bearings of capacity as recommended by bearing manufacturer for design load of trolley or bridge.

#### 2.3.9 Bearings

Bearings shall be antifriction type, except bearings which are subject only to small rocker motion. Equalizer sheaves shall be equipped with sintered oil-impregnated type bushings in accordance with ASTM B 438, ASTM B 439, or ASTM B 612.

#### 2.3.10 Anti-Drip Provisions

Cranes shall be designed to preclude leakage of lubricants onto the lifted loads or the floor. Equipment and components which cannot be made leak-proof shall be fitted with suitable drip pans. Drip pans shall be manufactured of steel and designed to permit removal of collected lubricant.

#### 2.3.11 Lubrication System

Splash-type oil lubrication system shall be provided for hoist, trolley and bridge gear cases; an oil pump shall be used on vertical-mounted gear cases exceeding 2 reductions. Oil pumps shall be the reversible type capable of maintaining the same oil flow direction and volume while being driven in either direction. Electric motor-driven pumps may be used when input shaft speed is too low at any operating condition to ensure adequate oil flow. In such applications, pump shall be energized whenever drive mechanism brakes are released.

### 2.4 ELECTRICAL COMPONENTS

#### 2.4.1 NOT USED

## 2.4.2 Control Systems

### 2.4.2.1 Hoist Control System

Main hoist and motion control system shall be two speed, with ac magnetic control of ac squirrel cage motor. Control shall provide for reversing, and for an automatically controlled eddy-current brake.

### 2.4.2.2 Travel Control System

Bridge and trolley motion control system shall be two speed with ac magnetic control of squirrel cage motors.

### 2.4.2.3 NOT USED

## 2.4.3 Power Sources

### 2.4.3.1 System Supply Voltage

Cranes shall be designed to be operated from a 208 volt, three-phase, 60 Hz, alternating current system power source. Energy isolating devices for such machine or equipment shall be designed to accept a lockout device in accordance with NFPA 70.

### 2.4.3.2 Transformers

Transformers shall be dry type suitable for the application.

### 2.4.3.3 NOT USED

## 2.4.4 Motors

### 2.4.4.1 General Requirements

Motors shall be designed specifically for crane and hoist duty. Drain holes shall be provided at low points near each end. Inspection and service covers shall be provided with gaskets. Hardware shall be corrosion-resistant. Motors shall conform to the requirements of NEMA MG 1.

### 2.4.4.2 Main and Auxiliary Hoist Motor

Hoist motor shall be two-speed; two-winding NEMA design D squirrel cage ac type.

### 2.4.4.3 Bridge and Trolley Drive Motors

Bridge and trolley drive motors shall be two-speed; two-winding NEMA design B squirrel cage ac type rated.

### 2.4.4.4 Motor Enclosures

Motor enclosures shall be totally enclosed, non-ventilated (TENV).

### 2.4.4.5 Hoist Motor Insulation and Time Rating

Hoist motors shall be provided with insulation which has a Class F/30 minute minimum motor time rating based on an 80 degree C motor temperature rise above 40 degrees C ambient, with frame size selection based on continuous ratings.



#### 2.4.4.6 Bridge and Trolley Motor Insulation and Time Rating

Bridge and trolley drive motors shall be provided with an insulation which has Class F/30 minute minimum motor time rating based on 85 degrees C motor temperature rise above 40 degree C ambient with frame size selection based on continuous rating.

#### 2.4.4.7 NOT USED

#### 2.4.5 Electric Brakes

##### 2.4.5.1 NOT USED

##### 2.4.5.2 NOT USED

##### 2.4.5.3 Automatic Stop System

Electrically-controlled brakes shall be fail-safe spring set when power is interrupted. Brakes shall be released with a mainline contactor POWER-OFF pushbutton or a master switch for the associated drive. Brakes shall automatically stop when there is a power failure. Electric shall be designed to be mechanically released. Enclosures for electrical-controlled brake components shall be NEMA ICS 6 Type 1.

#### 2.4.6 Control System

A separate controller shall be provided for each motor; a duplex type for 2-motor bridge drives and a quadraplex type for 4-motor bridge drives on ac central cranes. Overload protection shall be in conformance with requirements of NEMA ICS 2. Contactors used for starting, stopping and reversing, shall be mechanically and electrically interlocked.

##### 2.4.6.1 Control Panels

Control panels shall be fabricated of solid sheet steel designed and constructed to conform to requirements of NEMA ICS 6 Type 1. Control panel doors shall be hinged, equipped with gaskets and fitted with key-lock handle design, complete with a single key to open all locks.

##### 2.4.6.2 Main and Auxiliary Hoist Control

Hoist motor control system shall provide two speeds in each direction with an electrically-operated, full-magnetic, across-the-line reversing type starter. Electrical and mechanical interlocks shall be used to prevent the operation of high speeds and low speeds.

##### 2.4.6.3 Bridge and Trolley Control

Bridge and trolley main control systems shall provide two speeds in each direction with an electrically-operated, full-magnetic, across-the-line reversing type starter.

##### 2.4.6.4 NOT USED

##### 2.4.6.5 NOT USED

##### 2.4.7 NOT USED

#### 2.4.8 Pendant Control Station

#### 2.4.8.1 General

Pendant control station enclosure shall be NEMA Type 4. Physical size of pendant shall be held to a minimum. A separate cable of corrosion-resistant chain consisting of minimum 1/4 inch wire shall be provided. Pendant station shall be attached to underside of crane bridge footwalk or an auxiliary girder and shall hang vertically with bottom of pendant at 40 inches above floor. Weight of pendant shall not be supported by control cable.

#### 2.4.8.2 Operating Pushbuttons

Operating pushbuttons shall be heavy-duty, dust-and-oil-tight type with distinctly-felt operating positions which meet requirements of NEMA ICS 2. Pendant control buttons shall be momentary pushbuttons. Pushbuttons (except the POWER-OFF button) shall be the recessed type to avoid accidental operation. Diameter of buttons shall be a size which will make operation possible with a thumb while holding the pendant with same hand. Nameplates shall be provided adjacent to each pushbutton. Barriers shall be provided on pendant between various pushbutton functions, except on elements mounted in junction box. In a multi-speed application, dual-position pushbuttons shall have a definite click-detent position for each speed. Pushbuttons shall be designed and manufactured not to hang up in control case. Pendant shall include a separate set of pushbuttons for each motion and for POWER-ON POWER-OFF. Pushbuttons shall be as follows:

POWER-OFF. POWER-ON. Hoist-up. Hoist-down. Bridge-E. Bridge-W. Trolley-N. Trolley-S.

#### 2.4.8.3 Light Indicators

Pilot lights shall meet heavy-duty requirements of NEMA ICS 2. A blue pilot light shall be provided to indicate that the main contactor is energized, and a white pilot light to indicate that power is available on the load side of crane disconnect switch. A bright red mushroom head shall be provided with the POWER-OFF pushbutton.

#### 2.4.8.4 NOT USED

#### 2.4.8.5 NOT USED

#### 2.4.9 NOT USED

#### 2.4.10 Protection

##### 2.4.10.1 Main Line Disconnect

A main line disconnect consisting of a combination circuit breaker (22,000 AIC) and non-reversing starter, starter without overloads (mainline contactor) in NEMA Type 1 enclosure shall be provided. Mainline disconnect shall be controlled by a control circuit so that all crane motions will be stopped upon mainline undervoltage, overload, control circuit fuse failure, or operation of POWER OFF pushbutton. Mainline disconnect shall be equipped with energy isolating devices designed to accept lockout devices.

##### 2.4.10.2 NOT USED

#### 2.4.10.3 Surge Protection

Surge suppressors shall meet the requirements of UL 1449. Three metal oxide varistors shall be provided on the line side of each transformer to provide transient over-voltage protection.

#### 2.4.10.4 Circuit Breakers

Circuit breakers shall meet the requirements of UL 489.

#### 2.4.10.5 Overloads

Alternating current circuit overload relays shall be of the ambient compensated, automatic reset, inverse time type located in all phases individual motor circuits. Overload relays shall be arranged to de-energize the associated motor on an overload condition.

#### 2.4.11 Limit-Switches

Geared limit-switches shall be heavy-duty quick-break double-pole double-throw type conforming to NEMA ICS 2. The geared limit-switch interruption of a motion in one direction shall not prevent the opposite motion. Geared limit-switches shall reset automatically. Limit-switch housings shall be NEMA Type 1. Limit-switches shall interrupt power to the primary control systems.

##### 2.4.11.1 Hoist Upper Limit-Switches

Two limit-switches shall be provided for each hoist. A rotating-type adjustable geared-control circuit interrupt limit-switch shall provide hoist-up limiting. A secondary hoist-upper-limit shall be provided with a weight-operated power circuit limit-switch to prevent the hoist from raising beyond the safe limit. The secondary limit-switch shall operate to interrupt power to all hoist motor conductors, set the hoist holding brakes.

##### 2.4.11.2 Hoist Lower Limit-Switches

Hoists shall be provided with a rotating-type adjustable geared-control circuit interrupt limit-switch for hoist-down travel limiting. The hook downward vertical travel of the hook shall be field adjustable to approximately 6 inches above working surface.

##### 2.4.11.3 Bridge and Trolley Travel Limit-Switches

Runway (track-type) limit-switches shall be provided for crane bridge and trolley motions to stop the bridge and trolley motions, respectively. Limit-switch actuators shall be installed on building and trolley frame to actuate the limit-switches and stop the crane bridge or trolley prior to contacting the trolley frame bumpers. Trip mechanism for trolley motion shall be located on crane runway to trip the switch before the bumper contacts the stop. Trip mechanism for bridge motion shall be located on crane runway to trip switch before bumper contacts the stop. When the switch is tripped, the switch shall permit opposite travel in the direction of stop and then automatically reset.

##### 2.4.11.4 NOT USED

#### 2.4.12 Wiring

Wires shall be numbered or tagged at connection points. Splices shall be made in boxes or panels on terminals boards. Motor loop, branch circuit and brake

conductor selection shall be based on NFPA 70 for 75 degree C conductor rating. Wire insulation shall be Type XHHW.

#### 2.4.13 Electrification

##### 2.4.13.1 Main Power Electrification

Main power electrification system shall provide power to crane disconnect.

##### 2.4.13.2 Crane Runway Conductors

Crane runway conductor system shall be the covered conductor bar system type designed and manufactured to meet UL requirements. Protective covers shall be the rigid or flexible self-closing type designed to cover all live conductors and shall be shaped to prevent accidental contact with conductors. Collectors shall be heavy-duty sliding shoe type compatible with the electrification system. Two tandem designed collector heads shall be provided for each conductor rail to provide redundancy.

##### 2.4.13.3 Bridge Span Conductors

Bridge span conductor system shall be the festooned type consisting of a support rail, electrical cables, junction boxes, cable cars and accessories. Cable loops shall not drop below the hook high position.

##### 2.4.13.4 Pendant Festoon System

Pendant festoon system shall consist of a support rail, cables, junction boxes, cable cars and accessories. Cable loops shall not drop below the hook high position. Pendant control car shall be provided with NEMA Type 12 junction box. Pendant festoon shall be independent of trolley motion.

##### 2.4.13.5 NOT USED

##### 2.4.13.6 NOT USED

#### 2.4.14 Special Requirements

##### 2.4.14.1 Warning Horn

A solid-state electronic warning horn shall be provided on the crane. Any bridge or trolley motion shall be accompanied by a continuous series of alternating tones.

##### 2.4.14.2 THRU 2.4.14.7 NOT USED

##### 2.4.15 NOT USED

##### 2.4.16 NOT USED

##### 2.4.17 NOT USED

#### 2.5 NOT USED

### PART 3 EXECUTION

#### 3.1 ERECTION

The entire crane erection shall be performed in accordance with manufacturer's instructions under the full-time supervision of the manufacturer's

representative. Contractor shall provide a written certificate from crane manufacturer indicating the crane is erected in accordance with manufacturer's recommendations before testing the completed installation.

#### 3.1.1 Shop Assembly

Major crane components shall be shop assembled as completely as possible. Disassembled parts shall be match marked and electrical connections tagged after complete no-load shop testing. Parts and equipment at site shall be protected from weather, damage, abuse and loss of identification. Erection procedures shall ensure that the crane is erected without initial stresses, forced or improvised fits, misalignments, nicks of high-strength structural steel components, stress-raising welds and rough burrs. Damaged painted surfaces shall be cleaned and repainted after crane is erected.

#### 3.1.2 Mechanical Alignment

Motors, couplings, brakes, gear boxes and drive components shall be aligned when reinstalled in accordance with manufacturer's instructions.

#### 3.1.3 Electrical Alignment

Control system shall be aligned in accordance with manufacturer's instructions. A copy of the final alignment data shall be stored in control panel door and shall include but not be limited to timer settings, resistor tap settings, potentiometer settings, test-point voltages, supply voltages, motor voltages, motor currents and test conditions such as ambient temperature, motor load, date performed and person performing the alignment.

#### 3.1.4 Welding

Welders, welding operations and welding procedures shall be qualified or prequalified in accordance with AWS D14.1. Welding shall be performed indoors and the surface of parts to be welded shall be free from rust, scale, paint, grease or other foreign matter. Minimum preheat and interpass temperatures shall conform to the requirements of AWS D14.1. Welding shall be performed in accordance with written procedures which specify the Contractor's standard dimensional tolerances for deviation from camber and sweep. Such tolerances shall not exceed those specified in accordance with AWS D14.1. Allowable stress ranges shall be in accordance with MHI CMAA 70. Welding of girders and beams shall conform with AWS D14.1.

#### 3.1.5 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the facility, shall be as specified in SECTION 09900 PAINTING, GENERAL. Bridge crane including bridge, trolley, hoist and all attached items shall be painted in accordance with the manufacturer's standard practice. The complete crane shall be of one color. Bridge rail, supports and bracing shall be painted in accordance with Section C-09900 PAINTING, GENERAL. Items such as surfaces in contact with the rail wheels, wheel tread, hooks, wire rope, surfaces on the electrical collector bars in contact with the collector shoes and nameplates shall not be painted.

### 3.2 ACCEPTANCE TESTING

#### 3.2.1 General

Contractor shall provide all personnel necessary to conduct the required testing which shall include but not be limited to crane operators, riggers, rigging gear

and test weights. Testing shall be performed in the presence of Contracting Officer or his designated representative. Contractor shall notify Contracting Officer 10 days prior to testing operations. Contractor shall operate all equipment and make all necessary corrections and adjustments prior to the testing operations witnessed by Contracting Officer. A representative of the Contractor responsible for procuring and installing hoist equipment shall be present to direct the field testing. Operational testing shall not be performed until after building interior has been painted. Three copies of all test reports shall be furnished to Contracting Officer.

#### 3.2.1.1 Test Sequence

Crane shall be tested in accordance with applicable paragraphs of this procedure in the sequence provided.

#### 3.2.1.2 Test Data

Operating and startup current measurements shall be recorded for coils, hoist, trolley, and bridge motors using the appropriate instrumentation. Speed measurements shall be recorded as required by facility evaluation tests (normally at 100 percent load). Recorded values shall be compared with design specifications or manufacturer's recommended values and the abnormal differences shall be justified in the remarks or appropriate adjustments performed. The high temperatures or abnormal operation of any equipment or machinery shall be noted, investigated and corrected. Hoist, trolley and bridge speeds shall be recorded during each test cycle.

#### 3.2.1.3 Equipment Monitoring

Improper operation or poor condition of safety devices, electrical components, mechanical equipment and structural assemblies shall be monitored during the load test. Defects observed to be critical during the testing period shall be reported immediately to the Contracting Officer and the testing operations shall be suspended until the defects are corrected. During each load test and immediately following each load test, the following inspections shall be made:

- a. Inspect for evidence of bending, warping, permanent deformation, cracking or malfunction of structural components.

- b. Inspect for evidence of slippage in wire rope sockets and fittings.

- c. Check for overheating in brake operation; check for proper stopping. All safety devices including emergency stop switches and POWER-OFF pushbuttons shall be tested and inspected separately to verify proper operation of the brakes. When provided, safety accessories including warning horn, warning lights and alarm shall be inspected.

- d. Check for abnormal noise or vibration and overheating in machinery drive components.

- e. Check wire rope sheaves and drum spooling for proper reeving and operation, freedom of movement, abnormal noise or vibration.

- f. Check electrical drive components for proper operation, freedom from chatter, noise, overheating, and lockout/tagout devices for energy isolation.

- g. Inspect gears for abnormal wear patterns, damage, or inadequate lubrication.

h. Verify that locations of crane capacity plates are visible from pendant operator's position.

#### 3.2.1.4 Hooks

Hooks shall be measured for hook throat spread before and after load test. A throat dimension base measurement shall be established by installing 2 tram points and measuring the distance between the tram points to within 1/64 inch. This base dimension shall be recorded. Distance between tram points shall be measured before and after load test. An increase in throat opening by more than 1 percent from base measurement shall be cause for rejection.

#### 3.2.2 No-Load Testing

##### 3.2.2.1 Hoist Operating and Limit Switch Test

Load hook shall be raised and lowered through the full range of normal travel at rated speed and other crane speeds. Load hook shall be stopped below the geared limit-switch upper setting. In slow speed only, proper operation of upper and lower limit-switches for primary motion shall be verified. The test shall be repeated a sufficient number of times (minimum of 3) to demonstrate proper operation. Brake action shall be tested in each direction. Proper time-delay shall be verified between the actuation of dual brakes.

##### 3.2.2.2 Trolley Travel

Trolley shall be operated the full distance of bridge rails exercising all primary drive speed controls in each direction. Brake operation shall be verified in each direction. In slow speed trolley bumpers shall contact trolley stops located on the bridge girders. In slow speed the proper operation (interrupt power, automatic reset) of the trolley limit-switches at both limits of trolley motion shall be tested.

##### 3.2.2.3 Bridge Travel

Bridge shall be operated in each direction the full distance of runway exercising all primary drive speed controls. Brake operation shall be verified in each direction. In slow speed the proper operation (interrupt power, automatic reset) of the bridge limit-switches at both limits of bridge motion shall be tested. In slow speed or micro-drive the crane bridge bumpers shall contact the runway rail stops.

##### 3.2.2.4 Hoist Loss of Power No-Load Test

Using the primary drive, hooks shall be raised to a height of approximately 12 feet or less. While slowly lowering the hook the main power source shall be disconnected, verifying that the hook will not lower and that both brakes will set.

##### 3.2.2.5 Travel Loss of Power No-Load Test

With the hook raised to clear obstructions and trolley traveling in slow speed, the main power source shall be disconnected, verifying that the trolley will stop and the brake will set.

#### 3.2.3 Load Test

#### 3.2.3.1 Hoist

Unless otherwise indicated, the following tests shall be performed using a test load of 125 percent (plus 5 percent, minus 0 percent) of rated load.

a. Hoist Static Load Test: Holding brakes and hoisting components shall be tested by raising the test load approximately 1 foot and manually releasing one of the holding brakes. Load shall be held for 10 minutes. First holding brake shall be reapplied and second holding brake released. Load shall be held for 10 minutes. Any lowering that may occur indicates a malfunction of brakes or lowering components.

b. Dynamic Load Test: Test load shall be raised and lowered through the full range operating in each speed. Machinery shall be completely stopped at least once in each direction to ensure proper brake operation.

c. Hoist Mechanical Load Brake: With test load raised approximately 5 feet and with the hoist controller in the neutral position, the holding brake shall be released. The mechanical load brake shall be capable of holding the test load. With the holding brake in released position, the test load shall be lowered (first point) and the controller shall be returned to OFF position as the test load lowers. The mechanical load brake shall prevent the test load from accelerating.

d. Hoist Loss of Power Test: After raising test load to approximately 8 feet, slowly lowering the test load, the main power source and control pushbutton shall be released verifying that the test load will not lower and that both brakes will set.

e. Trolley Dynamic Load Test: While operating the trolley the full distance of bridge rails in each direction with test load on the hook (one cycle), proper functioning of all primary drive speed control points and proper brake action shall be tested.

f. Bridge Dynamic Load Test: With test load on hook, bridge shall be operated for the full length of runway in both directions with trolley at each extreme end of bridge. Proper functioning of all primary drive speed control points and brake action shall be verified.

#### 3.2.3.2 Trolley and Bridge Loss of Power Test

A test load of 100 to 105 percent of rated load shall be raised clear of any obstructions on operating floor. Starting at a safe distance from walls or other obstructions, a slow speed shall be selected using the trolley and bridge primary drive. While maintaining a safe distance to obstructions, the main power source shall be disconnected and brakes shall be verified to have set and that the equipment stops within the distance recommended by manufacturer.

#### 3.2.4 Overload Tests

After the operational tests, bridge crane system and all functions of bridge crane shall be tested at 125 percent of rated load.

#### 3.2.5 Acceleration and Deceleration Tests

The acceleration and deceleration of bridge and trolley shall be tested with approximately 10 percent of rated load at lowest possible location of hook. Bridge and trolley shall be operated to run up to high speed and then stopped without jarring or swinging the load.



#### 3.2.6 Grounding Test

Hoist shall be tested to determine that the hoist, including hook and pendant, are grounded to building during all phases of hoist operation. The grounding of bridge and trolley shall be tested with approximately 10 percent of rated load on hook. Grounding shall be tested between hoist hook and the structure's grounding system.

#### 3.2.7 Adjustments and Repairs

Adjustments and repairs shall be performed by Contractor under the direction of the Contracting Officer at no additional cost to the Government, until satisfactory conditions are maintained, and contract compliance is affected. After adjustments are made to assure correct functioning of the components, pertinent testing shall be repeated.

#### 3.3 SCHEMATIC DIAGRAMS

Schematic diagrams for equipment shall be delivered to the Contracting Officer.

#### 3.4 MANUFACTURER'S FIELD SERVICE REPRESENTATIVE

Contractor shall furnish a qualified experienced manufacturer's field service representative to supervise the crane installation, assist in the performance of the on site testing, and instruct personnel in the operational and maintenance features of the equipment.

#### 3.5 FIELD TRAINING

Contractor shall conduct a training course for the operating staff. Training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance. Course instructions shall cover pertinent points involved in operating, starting, stopping, and servicing the equipment, including all major elements of operation and maintenance manual. Course instructions shall demonstrate all routine maintenance operations such as lubrication and general inspection. Contracting Officer shall be given at least 2 weeks advance notice of field training.

#### 3.6 NOT USED

-- End of Section --

## SECTION C-15250

### THERMAL INSULATION FOR MECHANICAL SYSTEMS

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. At the discretion of the government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 580	(1995a) Stainless and Heat-Resisting Steel Wire
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 195	(1990) Mineral Fiber Thermal Insulating Cement
ASTM C 449	(1995) Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C 533	(1985; R 1990) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 534	(1994) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C 547	(1995) Mineral Fiber Pipe Insulation
ASTM C 552	(1991) Cellular Glass Thermal Insulation
ASTM C 553	(1992) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 612	(1993) Mineral Fiber Block and Board Thermal Insulation
ASTM C 647	(1995) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C 795	(1992) Thermal Insulation for Use in Contact With Austenitic Stainless Steel
ASTM C 871	(1995) Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions
ASTM C 916	(1985; Rev 1990) Adhesives for Duct Thermal Insulation
ASTM C 920	(1994) Elastomeric Joint Sealants

ASTM C 921	(1989 R; 1996) Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM C 1126	(1989; R 1994) Specification for faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
ASTM D 3278	(1989) Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus
ASTM E 84	(1996a) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS  
INDUSTRY (MSS)

MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
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MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA-01	(1993) National Commercial & Industrial Insulation Standards
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## 1.2 SYSTEM DESCRIPTION

Field-applied insulation and accessories on mechanical systems shall be as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated. Field applied insulation materials required for use on Government-furnished items as listed in the SPECIAL CONTRACT REQUIREMENTS shall be furnished and installed by the Contractor.

## 1.3 GENERAL QUALITY CONTROL

### 1.3.1 Standard Products

Materials shall be the standard products of manufacturers regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

### 1.3.2 Installer's Qualifications

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

### 1.3.3 Surface Burning Characteristics

Unless otherwise specified, insulation not covered with a jacket shall have a flame spread rating no higher than 75 and a smoke developed rating no higher than 150. The outside surface of insulation systems which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread rating no higher than 25 and a smoke developed rating no higher than 50. Insulation materials located exterior to the building perimeter are not required to be fire-rated. Flame spread and smoke developed ratings shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material that shall be used in the actual construction. Jackets shall comply with the flame spread and smoke developed ratings of 25/50 as determined by ASTM E 84.

#### 1.3.4 Identification of Materials

Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-14 Samples

Thermal Insulation Materials; GA.

A complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories for each mechanical system requiring insulation shall be included. Materials furnished under this section of the specification shall be submitted at one time.

After approval of materials and prior to applying insulation a booklet shall be prepared and submitted for approval. The booklet shall contain marked-up MICA-01 plates (or detail drawings showing the insulation material and insulating system) for each pipe, duct, or piece of equipment which is/are required to be insulated per this specification. The MICA plates shall be marked-up showing the materials to be installed in accordance with the requirements of this specification for the specific insulation application. The Contractor shall submit all MICA Plates required to show the entire insulating system, including Plates required to show insulation penetrations, vessel bottom and top heads, legs, and skirt insulation as applicable. If the Contractor elects to submit detailed drawings instead of marked-up MICA Plates, the detail drawings shall show cut-away, section views, and details indicating each component of the insulation system and showing provisions for insulating jacketing, and sealing portions of the equipment. For each type of insulation installation on the drawings, provide a label which identifies each component in the installation (i.e., the duct, insulation, adhesive, vapor retarder, jacketing, tape, mechanical fasteners, etc.) Indicate insulation by type and manufacturer. Three copies of the booklet shall be submitted at the jobsite to the Contracting Officer. One copy of the approved booklet shall remain with the insulation Contractor's display sample and two copies shall be provided for Government use.

After approval of materials actual sections of installed systems properly insulated in accordance with the specification requirements shall be displayed. Such actual sections must remain accessible to inspection throughout the job and will be reviewed from time to time for controlling the quality of the work throughout the construction site. Each material used shall be identified, by indicating on an attached sheet the specification requirement for the material and the material by each manufacturer intended to meet the requirement. Display sample sections will be inspected at the jobsite by the Contracting Officer. Approved display sample sections shall remain on display at the jobsite during the construction period. Upon completion of construction, the display sample sections will be closed and sealed.

Pipe Insulation Display Sections: Display sample sections shall include as a minimum an elbow or tee, a valve, dielectric unions and flanges, a hanger with protection shield and insulation insert, or dowel as required, at support point, method of fastening and sealing insulation at longitudinal lap, circumferential

lap, butt joints at fittings and on pipe runs, and terminating points for each type of pipe insulation used on the job, and for hot pipelines and cold pipelines, both interior and exterior, even when the same type of insulation is used for these services.

Duct Insulation Display Sections: Display sample sections for rigid and flexible duct insulation used on the job. A display section for duct insulation exposed to weather shall be protected by enclosing with a temporary covering.

## 1.5 STORAGE

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants by the Contractor. Insulation material and supplies that become dirty, dusty, wet, or otherwise contaminated may be rejected by the Contracting Officer.

## PART 2 PRODUCTS

### 2.1 GENERAL MATERIALS

Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either the wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C 795 requirements. Materials shall be asbestos free and conform to the following:

#### 2.1.1 Adhesives

##### 2.1.1.1 Acoustical Lining Insulation Adhesive

Insulation shall be applied in cut-to-size pieces attached to the interior of the duct with a nonflammable, fire-resistant adhesive conforming to ASTM C 916, Type I. Exposed edges of the liner at the duct ends and at other joints where the lining will be subject to erosion shall be coated with a heavy brush coat of the nonflammable, fire-resistant adhesive to prevent delamination of glass fibers.

##### 2.1.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C 195.

##### 2.1.1.3 Lagging Adhesive

Lagging adhesives shall be nonflammable and fire-resistant and shall have flame spread and smoke developed ratings of 25/50 when measured in accordance with ASTM E 84. Adhesives shall be either the Class 1 or Class 2 type as defined here. Class 1 adhesive shall be pigmented white and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bounding fibrous glass tape to joints of fibrous glass board; or for bonding lagging cloth to thermal insulation. Class 2 adhesive shall be pigmented white and be suitable for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations.

#### 2.1.2 Contact Adhesive

Adhesive may be dispersed in a nonhalogenated organic solvent with a low flash point (flash point less than minus 25 degrees F when tested in accordance with ASTM D 3278) or, dispersed in a nonflammable organic solvent which shall not have a fire point below 200 degrees F. The adhesive shall not adversely affect,

initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not omit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The adhesive shall be nonflammable and fire resistant.

#### 2.1.3 Caulking

ASTM C 920, Type S, Grade NS, Class 25, Use A.

#### 2.1.4 Corner Angles

Nominal 0.016 inch aluminum x 1 inch with factory applied kraft backing. Aluminum shall be ASTM B 209, Alloy 3003, 3105, or 5005.

#### 2.1.5 Finishing Cement

Mineral fiber hydraulic-setting thermal insulating cement ASTM C 449.

#### 2.1.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth and glass tape shall have flame spread and smoke developed ratings of no greater than 25/50 when measured in accordance with ASTM E 84. Fibrous glass cloth and tape; 20 x 20 maximum size mesh. Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces per square yard.

#### 2.1.7 Staples

Outward clinching type monel or ASTM A 167, Type 304 or 316 stainless steel.

#### 2.1.8 Jackets

ASTM C 921, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pound/inch width. ASTM C 921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pound/inch width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing.

##### 2.1.8.1 White Vapor Retarder ASJ (All Service Jacket)

For use on hot/cold pipes, ducts, or equipment. Vapor retarder jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing.

##### 2.1.8.2 Aluminum Jackets

Aluminum jackets shall be corrugated, embossed or smooth sheet, 0.016 inch nominal thickness; ASTM B 209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105 with factory applied moisture retarder. Corrugated aluminum jacket shall not be used outdoors. Aluminum jacket securing bands shall be Type 304 stainless steel, 0.015 inch thick, 1/2 inch wide for pipe under 12 inch diameter and 3/4 inch wide for pipe over 12 inch diameter. Aluminum jacket circumferential seam bands shall be 2 x 0.016 inch aluminum matching jacket material. Bands for insulation below ground shall be 3/4 x 0.020 inch thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the Contractor, be provided with a

factory fabricated Pittsburgh or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place.

#### 2.1.8.3 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, UV resistant rating or treatment and moderate chemical resistance with minimum thickness 0.030 inch. Insulation under PVC jacket shall meet jacket manufacturer's written recommendations.

#### 2.1.9 Vapor Retarder Coating

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall not exceed 0.05 perm and shall be determined according to procedure B of ASTM E 96 utilizing apparatus described in ASTM E 96. The coating shall be a nonflammable, fire resistant type. The flash point of the compound shall not be less than 80 degrees F and shall be determined in accordance with ASTM D 3278. All other application and service properties shall be in accordance with ASTM C 647.

#### 2.1.10 Wire

Soft annealed ASTM A 580 Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

### 2.2 PIPE INSULATION MATERIALS

Pipe insulation materials shall be as follows:

#### 2.2.1 Aboveground Cold Pipeline

Insulation for 30 degrees to Plus 60 degrees F shall be as follows:

##### 2.2.1.1 Cellular Glass

ASTM C 552, Type II, and Type III.

##### 2.2.1.2 Flexible Cellular Insulation

ASTM C 534, Type I or II. Type II shall have vapor retarder skin on both sides of the insulation.

##### 2.2.1.3 NOT USED

#### 2.2.2 Aboveground Hot Pipeline

For aboveground hot pipeline above 60 degrees F insulation the following requirements shall be met.

##### 2.2.2.1 Mineral Fiber

ASTM C 547, Class 1 or Class 2 as required for the operating temperature range.

##### 2.2.2.2 Calcium Silicate

ASTM C 533, Type I indoor only, or outdoors above 250 degrees F pipe temperature.

##### 2.2.2.3 Cellular Glass

ASTM C 552, Type II and Type III.

#### 2.2.2.4 Flexible Cellular Insulation

ASTM C 534, Type I or II to 200 degrees F service.

#### 2.2.2.5 NOT USED

#### 2.2.3 Below ground Pipeline Insulation

ASTM C 552, Type II.

### 2.3 DUCT INSULATION MATERIALS

Duct insulation materials shall be as follows:

#### 2.3.1 Rigid Mineral Fiber

ASTM C 612, Class 1.

#### 2.3.2 Flexible Mineral Fiber

ASTM C 553, Type I, Class B-2.

#### 2.3.3 Cellular Glass

ASTM C 552, Type I.

#### 2.3.4 NOT USED

#### 2.3.5 Flexible Cellular

ASTM C 534 Type II.

### 2.4 EQUIPMENT INSULATION MATERIALS

Equipment insulation materials shall be as follows:

#### 2.4.1 NOT USED

#### 2.4.2 Hot Equipment Insulation

For temperatures above 60 degrees F.

##### 2.4.2.1 Rigid Mineral Fiber

ASTM C 612, Type 2, 3, 4 or 5 as required for temperature encountered to 1800 degrees F.

##### 2.4.2.2 Flexible Mineral Fiber

ASTM C 553, Type 1, 2, 3, 4, 5, 6, or 7 as required for temperature encountered to 400 degrees F.

##### 2.4.2.3 Calcium Silicate

ASTM C 533, Type I, indoors only, or outdoors above 250 degrees F.

##### 2.4.2.4 Cellular Glass



ASTM C 552, Type I, Type III, or Type IV as required.

#### 2.4.2.5 Flexible Cellular Insulation

ASTM C 534, Type II, to 200 degrees F.

#### 2.4.2.6 NOT USED

### PART 3 EXECUTION

#### 3.1 APPLICATION - GENERAL

##### 3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if aforementioned cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA-01 standard plates except where modified herein or on the drawings.

##### 3.1.2 Fire stopping

Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with Fire stopping materials as specified in Section C-07270 FIRE STOPPING.

##### 3.1.3 Painting and Finishing

Painting shall be as specified in Section C-09900 PAINTING, GENERAL.

##### 3.1.4 Flexible Cellular Insulation

Flexible cellular insulation shall be installed with seams and joints sealed with a contact adhesive. Flexible cellular insulation shall not be used on surfaces greater than 200 degrees F. Seams shall be staggered when applying multiple layers of insulation. Insulation exposed to weather and not shown to have jacketing shall be protected with two coats of UV resistant finish as recommended by the manufacturer after the adhesive is dry.

##### 3.1.5 Welding

No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

##### 3.1.6 Pipes/Ducts/Equipment which Require Insulation

Insulation is required, unless stated otherwise, on all pipes, ducts, or equipment, which operate at or below 60 F and at or above 80 F.

## 3.2 PIPE INSULATION INSTALLATION

### 3.2.1 Pipe Insulation

#### 3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

- a. Pipe used solely for fire protection.
- b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.
- c. Sanitary drain lines.
- d. Unions in pipe above 60 degrees F.
- e. Strainers in pipe above 60 degrees F.
- f. Check valves in pipe above 60 degrees F.

#### 3.2.1.2 Pipes Passing Through Sleeves

- a. Pipe insulation shall be continuous through the sleeve.
- b. An aluminum jacket with factory applied moisture retarder shall be provided over the insulation wherever penetrations require sealing.
- c. Where penetrating interior walls, the aluminum jacket shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band.
- d. Where penetrating floors, the aluminum jacket shall extend from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.
- e. Where penetrating exterior walls, the aluminum jacket required for pipe exposed to weather shall continue through the sleeve to a point 2 inches beyond the interior surface of the wall.

#### 3.2.1.3 Pipes Passing Through Hangers

- a. Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-69. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed.
- b. Horizontal pipes larger than 2 inches at 60 degrees F and above shall be supported on hangers in accordance with MSS SP-69.

c. Horizontal pipes larger than 2 inches below 60 degrees F shall be supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-69. An insulation insert of cellular glass or calcium silicate shall be installed above each shield. The insert shall cover not less than the bottom 180 degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.

d. Vertical pipes shall be supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-69 covering the 360 degree arc of the insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360 degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation as an option instead of installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert. The vertical weight of the pipe shall be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 30 feet, the weight of the pipe shall be additionally supported with hangers in the vertical run of the pipe which are directly clamped to the pipe, penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.

e. Inserts shall be covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, shall overlap the adjoining pipe jacket 1-1/2 inches, and shall be sealed as required for the pipe jacket. The jacket material used to cover inserts in flexible cellular insulation shall conform to ASTM C 921, Type 1, and is allowed to be of a different material than the adjoining insulation material.

#### 3.2.1.4 Pipes Passing Through Walls

a. For hot water pipes supplying lavatories or other similar heated service which requires insulation, the insulation shall be terminated on the backside of the finished wall. The insulation termination shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch applied with glass tape embedded between coats (if applicable). The coating shall extend out onto the insulation 2 inches and shall seal the end of the insulation. Glass tape seams shall overlap 1 inch. Caulk the annular space between the pipe and wall penetration. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration at least 3/8 inch.

b. For domestic cold water pipes requiring insulation, the insulation shall be terminated on the finished side of the wall (i.e. insulation must cover the pipe throughout the wall penetration). The insulation shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch. The coating shall extend out onto the insulation 2 inches and shall seal the end of the insulation. Caulk the annular space between the pipe and wall penetration. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration by at least 3/8 inch.

### 3.2.1.5 Flexible Cellular Pipe Insulation

Flexible cellular pipe insulation shall be tubular form for pipe sizes 6 inches and less. Type II sheet insulation used on pipes larger than 6 inches shall not be stretched around the pipe. On pipes larger than 12 inches, adhere insulation directly to the pipe on the lower 1/3 of the pipe. Seams shall be staggered when applying multiple layers of insulation. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation.

### 3.2.2 Aboveground Cold Pipelines

The following shall be included for aboveground cold pipelines minus 30 degrees to plus 60 degrees F:

- a. Domestic cold and chilled drinking water.
- b. Make-up water.
- c. Refrigerant suction lines.
- d. Air conditioner condensate drains.

#### 3.2.2.1 Insulation Thickness

TABLE I  
Pipe Size (Inches)

Service or Range of Temp (degrees F)	Run- outs* Up to 2"	1" and Less	1-1/4 to 2	2-1/2 to 4	5 to 6	8" and Larger
60 to 35 (FC)	1/2	1	1	1	1	1
(CG)	1-1/2	1-1/2	1-1/2	2	2	2
34 to 0 (CG)		2	2	2	2-1/2	3
(FC)		1	1	1-1/4	1-1/4	1-1/2
-1 to -30 (CG)		2-1/2	2-1/2	3	3	3
(FC)		1-1/2	1-1/2	1-1/2	1-1/2	1-1/2
Domestic (FC)		3/8	3/8	3/8	3/8	3/8
Cold Water (CG)		1-1/2	1-1/2	1-1/2	1-1/2	1-1/2

#### NOTES:

CG - Cellular Glass FC - Flexible Cellular

\*When runouts to terminal units exceed 12 feet, the entire length of runout shall be insulated like main feed pipe.

#### 3.2.2.2 Jacket for Fibrous, and Cellular Glass, Insulated Pipe

Insulation shall be covered with a factory applied vapor retarder jacket or field applied seal welded PVC jacket. Insulation inside the building shown to be protected with an aluminum jacket shall have the insulation and vapor retarder jacket installed as specified herein. The aluminum jacket shall be installed as specified for piping exposed to weather, except sealing of the laps of the

aluminum jacket is not required. In high abuse areas such as janitor closets and traffic areas in equipment rooms, and mechanical rooms, aluminum jackets shall be utilized. Pipe insulation to the 5 ft level will be protected.

#### 3.2.2.3 Insulation for Straight Runs (Fibrous and Cellular Glass)

a. Insulation shall be applied to the pipe with joints tightly butted. The ends of fibrous insulation shall be sealed off with vapor retarder coating at intervals not to exceed 15 feet.

b. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches. Butt strips 3 inches wide shall be provided for circumferential joints.

c. Laps and butt strips shall be secured with adhesive and stapled on 4 inch centers if not factory self-sealing.

d. Factory self-sealing lap systems may be used when the ambient temperature is between 40 degrees and 120 degrees F during installation. The lap system shall be installed in accordance with manufacturer's recommendations. Stapler shall be used only if specifically recommended by the manufacturer. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.

e. All Staples, including those used to repair factory self-seal lap systems, shall be coated with a vapor retarder coating. All seams, except those on factory self-seal systems shall be coated with vapor retarder coating.

f. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and securing it with adhesive, stapling, and coating with vapor retarder coating. The patch shall extend not less than 1-1/2 inches past the break.

g. At penetrations such as thermometers, the voids in the insulation shall be filled and sealed with vapor retarder coating.

#### 3.2.2.4 Insulation for Fittings and Accessories

a. Pipe insulation shall have ends thoroughly coated with a vapor retarder coating not less than 6 inches from each flange, union, valve, anchor, or fitting in all directions.

b. Precut, preformed insulation for placement over fittings, flanges, unions, valves, anchors, and mechanical couplings shall be used. Precut, preformed insulation shall exhibit the same properties as the adjoining pipe insulation. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation should be overlapped 2 inches or one pipe diameter. Loose fill mineral fiber or insulating cement shall be used to fill the voids. Elbows insulated using segments shall not have less than 3 segments per elbow.

c. Upon completion of installation of insulation on flanges, unions, valves, anchors, fittings and accessories, terminations and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with two coats of vapor retarder coating with a minimum total thickness of 1/16 inch, applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. The coating shall extend out onto the adjoining pipe insulation 2 inches.

d. Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface.

e. Flexible connections at pumps and other equipment shall be insulated with 1/2 inch flexible cellular insulation, unless otherwise indicated.

f. Insulation shall be marked showing the location of unions, strainers, and check valves.

#### 3.2.2.5 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor retarder and embedded glass tape. Factory premolded insulation segments shall be used under the fitting covers for elbows. Insulation segments shall be the same thickness as adjoining pipe insulation and the insulation shall be protected with one coat of vapor retarder coating under the PVC cover. The covers shall be secured by PVC vapor retarder tape, adhesive, seal-welding or with tacks made for securing PVC covers. Seams in the cover, and tacks and laps to adjoining pipe insulation jacket, shall be sealed with vapor retarder tape to ensure that the assembly has a continuous vapor seal.

#### 3.2.3 Aboveground Hot Pipelines

For hot pipelines above 60 degrees F the following shall be included:

- a. Domestic hot water.
- b. Hot water heating.

##### 3.2.3.1 Insulation Thickness

Insulation thickness shall be determined using the manufacturer's published thermal conductivity k, and TABLE II. Insulation thickness for pipelines handling 60 degrees F to 200 degrees F domestic hot water shall be as indicated in TABLE III.

TABLE II

REQUIRED THICKNESS (IN INCHES) OF PIPE INSULATION  
FOR HANDLING FLUIDS OTHER THAN  
DOMESTIC HOT WATER TO 250 DEGREES F

k = thermal conductivity (average) Btu/hr. sq. ft.  
degree/in. thickness at a mean temperature of 75 degrees F

Thermal conductivity k	Pipe Size, Inches						
	2 or less	2-1/2 to 3	4	5 to 6	8	10	12
0.25	1.5	1.5	2.0	2.0	2.0	2.0	2.5
0.30	1.5	2.0	2.5	2.5	2.5	2.5	3.0
0.35	2.0	2.5	2.5	2.5	3.5	3.5	3.5
0.40	2.5	3.5	3.5	3.0	4.0	4.0	4.0
0.45	3.0	4.0	4.0	3.5	4.5	4.5	4.5

TABLE III

REQUIRED THICKNESS (IN INCHES) OF PIPE INSULATION  
FOR PIPES HANDLING DOMESTIC HOT WATER.  
CG - CELLULAR GLASS      FC - FLEXIBLE CELLULAR

Range of Service (degrees F)	Runouts*		Pipe Size, Inches			
	Up to 2"	1 or less	1-1/4 to 2"	2-1/2 to 4	5 to 6	8 & Larger
61 to 200	(CG)	1.5	2.0	2.0	2.0	2.5
	(FC)    ½	1.0	1.0	1.5	1.5	1.5

\*When runouts to terminal units exceed 12 feet, the entire length of runout shall be insulated like the main feed pipe.

#### 3.2.3.2 Jacket for Insulated Pipe

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type II jacket or field applied aluminum where required or seal welded PVC.

#### 3.2.3.3 Insulation for Straight Runs

- a. Insulation shall be applied to the pipe with joints tightly butted.
- b. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches, and butt strips 3 inches wide shall be provided for circumferential joints.
- c. Laps and butt strips shall be secured with adhesive and stapled on 4 inch centers if not factory self-sealing. Adhesive may be omitted where pipe is concealed.
- d. Factory self-sealing lap systems may be used when the ambient temperature is between 40 degrees and 120 degrees F and shall be installed in accordance with manufacturer's instructions. Laps and butt strips shall be stapled whenever there is nonadhesion of the system. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.
- e. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and be secured with adhesive and stapled on 4 inch centers if not factory self-sealing. Adhesive may be omitted where pipe is concealed. Patch shall extend not less than 1-1/2 inches past the break.
- f. Install flexible cellular pipe insulation by slitting tubular sections and applying onto piping or tubing. Alternately, whenever possible, slide unslit sections over the open ends of piping or tubing. All seams and butt joints shall be secured and sealed with adhesive. When using self seal products only the butt joints shall be secured with adhesive. Insulation shall be pushed on the pipe, never pulled. Stretching of insulation may result in open seams and joints. All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted. Proper tools such as sharp knives must be used. Type II sheet insulation when used on pipe larger than 6 inches shall not be stretched around the pipe. On pipes larger than 12 inches, adhere sheet insulation directly to the pipe on the lower 1/3 of the pipe.

#### 3.2.3.4 Insulation for Fittings and Accessories

a. The run of the line pipe insulation shall have the ends brought up to the item.

b. Insulation of the same thickness and conductivity as the adjoining pipe insulation, either premolded or segmented, shall be placed around the item abutting the adjoining pipe insulation, or if nesting size insulation is used, overlapping 2 inches or one pipe diameter. Loose fill mineral fiber or insulating cement shall be used to fill the voids. Insulation for elbows less than 3 inch size shall be premolded. Insulation for elbows 3 inch size and larger shall be either premolded or segmented. Elbows insulated using segments shall have not less than 3 segments per elbow. Insulation may be wired or taped on until finish is applied.

c. Upon completion of installation of insulation on flanges, unions, valves, anchors, fittings and accessories, terminations and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with two coats of Class 1 adhesive applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. Adhesive shall extend onto the adjoining insulation not less than 2 inches. The total dry film thickness shall be not less than 1/16 inch.

d. Insulation terminations shall be tapered to unions at a 45-degree angle.

e. At the option of the Contractor, factory premolded one- or two-piece PVC fitting covers may be used in lieu of the adhesive and embedded glass tape. Factory premolded segments or factory or field cut blanket insert insulation segments shall be used under the cover and shall be the same thickness as adjoining pipe insulation. The covers shall be secured by PVC vapor retarder tape, adhesive, seal-welding or with tacks made for securing PVC covers.

#### 3.2.4 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, an aluminum jacket shall be applied. PVC jacketing requires no factory applied jacket beneath it. Flexible cellular insulation exposed to weather shall be treated in accordance with paragraph FLEXIBLE CELLULAR INSULATION.

##### 3.2.4.1 Aluminum Jacket

The jacket for hot piping may be factory applied. The jacket shall overlap not less than 2 inches at longitudinal and circumferential joints and shall be secured with bands at not more than 12 inch centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints on piping 60 degrees F and below shall be sealed with caulking while overlapping to prevent moisture penetration. Where jacketing on piping 60 degrees F and below abuts an uninsulated surface, joints shall be caulked to prevent moisture penetration. Joints on piping above 60 degrees F shall be sealed with a moisture retarder.

##### 3.2.4.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of an emulsion type weatherproof mastic recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 1 inch and the adjoining aluminum jacket not less than 2 inches. Factory preformed



aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be used with PVC lagging and adhesive welded moisture tight.

#### 3.2.4.3 PVC Lagging

PVC lagging shall be ultraviolet resistant and adhesive welded vapor tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

#### 3.2.5 NOT USED

### 3.3 DUCT INSULATION INSTALLATION

Corner angles shall be installed on external corners of insulation on ductwork in exposed finished spaces before covering with jacket. Duct insulation shall be omitted on the following:

- a. Factory fabricated double wall internally insulated duct.
- b. Glass fiber duct.
- c. Site-erected air conditioning casings and plenums constructed of factory-insulated sheet metal panels.
- d. Ducts shown to be internally lined with insulation or sound absorbing material, unless indicated otherwise.
- e. Factory preinsulated flexible ducts.
- f. Ducts within HVAC equipment.
- g. Exhaust air ducts unless noted.
- h. Ceilings which form plenums.

#### 3.3.1 Duct Insulation Thickness

Duct insulation thickness shall be in accordance with Table IV.

Table IV - Minimum Duct Insulation (inches)

Cold Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5
Warm Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5

#### 3.3.2 Insulation and Vapor Retarder for Cold Air Duct

Insulation and vapor retarder for cold air duct below 60 degrees F: Ducts and associated equipment shall be insulated to a thickness which is in accordance with Table IV. The following shall be insulated:

- a. Supply ducts.
- b. Return air ducts.
- c. Relief ducts.
- d. Flexible runouts (field-insulated).
- e. Plenums.
- f. Duct-mounted VAV boxes.

- g. Fresh air intake ducts.
- h. Filter boxes.
- i. Site-erected air conditioner casings.
- j. Combustion air intake ducts.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf and rigid type where exposed, minimum density 3 pcf. Insulation for round/oval ducts shall be flexible type, minimum density 3/4 pcf with a factory Type I jacket; or, a semi rigid board, minimum density 3 pcf, formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered, with a factory applied Type I all service jacket. Insulation for exposed ducts shall be provided with either a white, paintable, factory-applied Type I jacket or a vapor retarder jacket coating finish as specified. Fibrous and cellular glass insulation on concealed duct shall be provided with a factory-applied Type I vapor retarder jacket. The total dry film thickness shall be approximately 1/16 inch. Duct insulation shall be continuous through sleeves and prepared openings except fire wall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor retarder shall cover the collar, neck, and any uninsulated surfaces of diffusers, registers and grills. Vapor retarder materials shall be applied to form a complete unbroken vapor seal over the insulation.

#### 3.3.2.1 Installation on Concealed Duct

a. For rectangular, oval or round ducts, insulation shall be attached by applying Class 2 adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts, 24 inches and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corners.

c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corners.

d. Insulation shall be impaled on the mechanical fasteners where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor retarder jacket joints overlap 2 inches. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.

e. Self-locking washers shall be installed where mechanical fasteners are used. The pin shall be trimmed back and bent over.

f. Jacket overlaps shall be secured under the overlap with Class 2 adhesive and stapled on 4 inch centers. Staples and seams shall be coated with a brush coat of vapor retarder coating.

g. Breaks in the jacket material shall be covered with patches of the same material as the vapor retarder. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with Class 2 adhesive and staples. Staples and joints shall be sealed with a brush coat of vapor retarder coating.

h. At jacket penetrations such as hangers thermometers and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor retarder coating.

i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and uninsulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

#### 3.3.2.2 Installation on Exposed Duct Work

a. For rectangular ducts, rigid insulation shall be secured to the duct by mechanical fasteners on all four sides of the duct, spaced not more than 12 inches apart and not more than 3 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger. One row shall be provided for each side of duct less than 12 inches.

b. Duct insulation shall be formed with minimum jacket seams. Each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor retarder jacket shall be continuous across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, insulation and jacket shall be carried over.

c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and the pin trimmed and bent over.

d. Joints in the insulation jacket shall be sealed with a 4 inch wide strip of the same material as the vapor retarder jacket. The strip shall be secured with Class 2 adhesive and stapled. Staples and seams shall be sealed with a brush coat of vapor retarder coating.

e. Breaks and ribs or standing seam penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with Class 2 adhesive and stapled. Staples and joints shall be sealed with a brush coat of vapor retarder coating.

f. At jacket penetrations such as hangers, thermometers, and damper operating rods, the voids in the insulation shall be filled and the penetrations sealed with a brush coat of vapor retarder coating.

g. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and uninsulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

h. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation with minimum density of 3/4 pcf attached by applying Class 2 adhesive around the entire perimeter of the duct in 6 inch wide stripe on 12 inch centers.

#### 3.3.3 Insulation for Warm Air Duct

For warm air ducts above 60 degrees F, ducts and associated equipment shall be insulated to a thickness which is in accordance with Table IV. The following shall be insulated:

- a. Supply ducts.
- b. Return air ducts.
- c. Relief air ducts.
- d. Flexible runouts (field insulated).
- e. Plenums.
- f. Duct-mounted coil casings.
- g. Coil-headers and return bends.
- h. Coil casings.
- i. Fresh air intake ducts.
- j. Filter boxes.
- k. Mixing boxes.
- l. Supply fans.
- m. Site-erected air conditioner casings.
- n. Ducts exposed to weather.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf; and rigid type where exposed, minimum density 3 pcf. Insulation on exposed ducts shall be provided with a white, paintable, factory-applied Type II jacket, or finished with Class 1 adhesive finish. Flexible type insulation shall be used for round ducts, minimum density 3/4 pcf with a factory-applied Type II jacket. Insulation on concealed duct shall be provided with a factory-applied Type II jacket. Class 1 adhesive finish where indicated to be used shall be accomplished by applying two coats of Class 1 adhesive with a layer of glass cloth embedded between the coats. The total dry film thickness shall be approximately 1/16 inch. Duct insulation shall be continuous through sleeves and prepared openings. Duct insulation shall terminate at fire dampers and flexible connections.

#### 3.3.3.1 Installation on Concealed Duct

a. For rectangular, oval and round ducts, insulation shall be attached by applying Class 2 adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts 24 inches and larger, insulation shall be secured to the bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corner.

c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corners.

d. The insulation shall be impaled on the mechanical fasteners where used and shall be pressed thoroughly into the adhesive. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type hangers.

e. Self-locking washers shall be installed where mechanical fasteners are used and the pin trimmed and bent over.

f. Insulation jacket shall overlap not less than 2 inches at joints and the lap shall be secured with Class 2 adhesive under the lap and stapled on 4 inch centers.

#### 3.3.3.2 Installation on Exposed Duct

a. For rectangular ducts, the rigid insulation shall be secured to the duct by the use of mechanical fasteners on all four sides of the duct, spaced not more than 12 inches apart and not more than 3 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger and a minimum of one row for each side of duct less than 12 inches.

b. Duct insulation with factory-applied jacket shall be formed with minimum jacket seams, and each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projection is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over the projection. Jacket shall be continuous across seams, reinforcing, and projections. Where the height of projections is greater than the insulation thickness, insulation and jacket shall be carried over the projection.

c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and pin excess clipped and bent over.

d. Joints on jacketed insulation shall be sealed with a 4 inch wide strip of the same material as the jacket. The strip shall be secured with Class 2 adhesive and stapled.

e. Breaks and penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with Class 2 adhesive and stapled.

f. Insulation terminations and pin punctures shall be sealed and flashed with a Class 1 adhesive. Two coats of Class 1 adhesive coating shall be applied with glass cloth embedded between coats. The total coating shall have a dry film thickness of approximately 1/16 inch and shall overlap the adjoining insulation and uninsulated surface 2 inches.

g. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation, minimum density of 3/4 pcf attached by applying Class 2 adhesive around the entire perimeter of the duct in 6 inch wide stripe on 12 inch center. Joints shall be sealed with a 4 inch wide strip of the same material as the jacket. The strip shall be secured with Class 2 adhesive and stapled.

#### 3.3.4 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose below and above 60 degrees F, ducts shall be insulated as specified for cold air duct.

#### 3.3.5 NOT USED

### 3.3.6 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

### 3.3.7 NOT USED

## 3.4 EQUIPMENT INSULATION INSTALLATION

### 3.4.1 General

Removable insulation sections shall be provided to cover parts of equipment which must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories. Equipment insulation shall be omitted on the following:

- a. Handholes.
- b. Boiler manholes.
- c. Cleanouts.
- d. ASME stamps.
- e. Manufacturer's nameplates.

### 3.4.2 Insulation for Cold Equipment

Cold equipment below 60 degrees F: Insulation shall be furnished on equipment handling media below 60 degrees F including the following:

- a. Refrigeration equipment parts that are not factory insulated.
- b. Drip pans under chilled equipment.
- c. Air handling equipment parts that are not factory insulated.

#### 3.4.2.1 Insulation Type

Insulation shall be suitable for the temperature encountered. Thicknesses shall be as follows:

- a. Equipment Handling Media Between 35 and 60 degrees F: 2 inch thick cellular glass, 1-1/2 inch thick flexible cellular, or 1 inch thick phenolic foam.
- b. Equipment Handling Media Between 0 degree F and 34 degrees F: 3-1/2 inch thick cellular glass, 2-1/2 inch flexible cellular, or 1-1/2 inch thick phenolic foam.
- c. Equipment Handling Media Between minus 30 degrees F and 1 degree F: 4 inch thick cellular glass 3 inch thick flexible cellular, or 1-1/2 inch thick phenolic foam.

#### 3.4.2.2 NOT USED

#### 3.4.2.3 Other Equipment

- a. Insulation shall be formed or fabricated to fit the equipment. To ensure

a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.

b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not more than 12 inch centers except flexible cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.

c. Cellular glass and phenolic foam insulation shall be set in a coating of bedding compound, and joints shall be sealed with bedding compound as recommended by the manufacturer. Mineral fiber insulation joints shall be filled with finishing cement.

d. Exposed insulation corners shall be protected with corner angles.

#### 3.4.2.4 Vapor Retarder

Upon completion of installation of insulation, penetrations shall be caulked. Two coats of vapor retarder coating shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line between equipment and removable section insulation.

#### 3.4.3 Insulation for Hot Equipment

Hot equipment above 60 degrees F: Insulation shall be furnished on equipment handling media above 60 degrees F including the following:

- a. Water heaters.
- b. Pumps handling media above 130 degrees F.
- c. Boiler flue gas connection from boiler to stack (if inside).

##### 3.4.3.1 Insulation

Insulation shall be suitable for the temperature encountered. Insulation thicknesses shall be as follows:

a. Equipment handling media to 600 degrees F: 5 inch thick rigid mineral fiber, 6 inch thick flexible mineral fiber, 6 inch thick calcium silicate, 6 inch thick cellular glass.

b. Equipment handling media above 600 degrees F: Insulate with a thickness of material required to limit the external temperature of the insulation to 120 degrees F. Heat transfer calculations shall be submitted to substantiate insulation and thickness selection.

##### 3.4.3.2 Insulation of Pumps

Pumps shall be insulated by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints which do not leave raw ends of insulation exposed. Bottom and sides shall be banded to form a rigid housing which does not rest on the pump. Joints between top cover and sides shall fit tightly. The top cover shall have a joint forming a female shiplap joint on the side pieces and a male joint on the top cover, thus making the top cover removable. Two coats of Class I adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the

insulation coating. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line of the removable sections and penetrations.

#### 3.4.3.3 Other Equipment

a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.

b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not greater than 12 inch centers except flexible cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.

c. On high vibration equipment, cellular glass insulation shall be set in a coating of bedding compound as recommended by the manufacturer, and joints shall be sealed with bedding compound. Mineral fiber joints shall be filled with finishing cement.

d. Exposed insulation corners shall be protected with corner angles.

e. Upon completion of installation of insulation, penetrations shall be caulked. Two coats of Class I adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line between equipment and removable section insulation.

#### 3.4.4 Equipment Handling Dual Temperature Media

Below and above 60 degrees F: Equipment handling dual temperature media shall be insulated as specified for cold equipment.

#### 3.4.5 NOT USED

--END OF SECTION--



SECTION C-15330

WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47	(1990) Ferritic Malleable Iron Castings
ASTM A 53	(1995a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 135	(1993) Electric-Resistance-Welded Steel Pipe
ASTM A 183	(1983; R 1990) Carbon Steel Tract Bolts and Nuts
ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM A 795	(1995) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM B 88	(1995a) Seamless Copper Water Tube

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.4	(1992) Cast Iron Threaded Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1991) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings

ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B18.2.1	(1981; Supple 1991; R 1992) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(1987; R 1993) Square and Hex Nuts (Inch Series)

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1013	(1993) Reduced Pressure Zone Backflow Prevention Assembly
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AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA-10062JU	(1992) Standard Methods for the Examination of Water and Wastewater
AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA C104	(1990) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA C111	(1990) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151	(1991) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C203	(1991) Coal-tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA M20	(1973) Manual: Water Chlorination Principles and Practices

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825 (1995; Supple I, II & III) Approval Guide

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS  
INDUSTRY (MSS)

MSS SP-71 (1990) Cast Iron Swing Check Valves, Flanges and  
Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13 (1994) Installation of Sprinkler Systems

NFPA 24 (1995) Installation of Private Fire Service Mains and  
Their Appurtenances

NFPA 231C (1995) Rack Storage of Materials

NFPA 1963 (1993) Fire Hose Connections

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES  
(NICET)

NICET 1014 (1995) Detail Manual for Certification in the Field of  
Fire Protection Engineering Technology (Field 003)  
Automatic Sprinkler System Layout

UNDERWRITERS LABORATORIES (UL)

UL-01 (1996) Building Materials Directory

UL-04 (1996; Supple) Fire Protection Equipment Directory

UL 668 (1989; Rev Feb 1994) Hose Valves For Fire Protection  
Service

1.2 GENERAL REQUIREMENTS

Wet pipe sprinkler system shall be provided in areas indicated on the drawings. The sprinkler system shall provide fire sprinkler protection for the entire area. Except as modified herein, the system shall be designed and installed in accordance with NFPA 13. Pipe sizes which are not indicated on drawings shall be determined by hydraulic calculation.

### 1.2.1 Hydraulic Design

The system shall be hydraulically designed to discharge a minimum density of 0.20 gpm per square foot over the hydraulically most demanding 3,000 square feet of floor area. The minimum pipe size for branch lines in gridded systems shall be 1-1/4 inch. Hydraulic calculations shall be in accordance with the Area/Density Method of NFPA 13.

#### 1.2.1.1 Hose Demand

An allowance for exterior hose streams of 500 gpm shall be added to the sprinkler system demand at the fire hydrant closest to the point where the water service enters the building.

#### 1.2.1.2 Basis for Calculations

The design of the system shall be based upon a water supply with a static pressure of 62 psig, and a flow of 1100 gpm at a residual pressure of 35 psig. Water supply shall be presumed available at the base of the riser. Hydraulic calculations shall be based upon the Hazen-Williams formula with a "C" value of 120 for steel piping, 150 for copper tubing, 140 for new cement-lined ductile-iron piping, and 140 for existing underground piping.

#### 1.2.2 Sprinkler Spacing

Sprinklers shall be uniformly spaced on branch lines. Maximum spacing per sprinkler shall not exceed limits specified in NFPA 13 for the hazard occupancies indicated.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. Submittals related to system configuration, hydraulic calculations, and equipment selection, including manufacturer's catalog data, working drawings, connection drawings, control diagrams and certificates shall be submitted concurrently as a complete package. The package will be reviewed by the U.S. Army Engineer District Fire Protection Engineer. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

#### SD-01 Data

##### Load Calculations for Sizing Sway Bracing

For systems that are required to be protected against damage from earthquakes, load calculations shall be provided for sizing of sway bracing.

##### Sprinkler System Equipment; GA.

Manufacturer's Catalog Data for each separate piece of equipment proposed for use in the system. Data shall indicate the name of the manufacturer of each item of equipment, with data highlighted to indicate model, size, options, etc. proposed for installation. In addition, a complete equipment list which includes equipment description, model number and quantity shall be provided.

##### Hydraulic Calculations; GA.

Hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments.

##### Spare Parts; FIO.

Spare parts data shall be included for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

#### SD-04 Drawings

Sprinkler System Shop Drawings; GA.

Detail drawings conforming to the requirements established for working plans as prescribed in NFPA 13. Drawings shall include plan and elevation views which establish that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

b. Floor plans drawn to a scale not less than  $1/8" = 1'-0"$  which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.

c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

d. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.

e. Details of each type of riser assembly; pipe hanger; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring.

As-Built Drawings; GA.

As-built drawings, no later than 14 working days after completion of the Final Tests. The sprinkler system shop drawings shall be updated to reflect as-built conditions after work is completed and shall be on reproducible full-size mylar film.

#### SD-06 Instructions

Test Procedures; GA.

Proposed test procedures for piping hydrostatic test, testing of alarms, at least 14 days prior to the start of related testing.

#### SD-07 Schedules

Preliminary Tests; GA.

A schedule of preliminary tests, at least 14 days prior to the proposed start of the tests.

Final Test; GA.

Upon successful completion of tests specified under PRELIMINARY TESTS, written notification shall be given to the Contracting Officer of the date for the final acceptance test. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates.

#### SD-08 Statements

Installer Qualifications; GA.

Qualifications of the sprinkler installer.

Submittal Preparer's Qualifications; GA.

The name and documentation of certification of the individual who will prepare the submittals, prior to the submittal of the drawings and hydraulic calculations.

#### SD-13 Certificates

Contractor's Material & Test Certificates; FIO.

Certificates, as specified in NFPA 13, shall be completed and signed by the Contractor's Representative performing required tests for both underground and aboveground piping.

#### SD-19 Operation and Maintenance Manuals

Sprinkler System; FIO.

Manuals shall be in loose-leaf binder format and grouped by technical sections consisting of manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. The manuals shall list routine maintenance procedures possible breakdowns, and repairs, and troubleshooting guide. This shall include procedures and instructions pertaining to frequency of preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.

### 1.4 HYDRAULIC CALCULATIONS

Hydraulic calculations shall be as outlined in NFPA 13 except that calculations shall be performed by computer using software specifically designed for fire protection system design. Software which uses k-factors for typical branch lines is not acceptable. Calculations shall be taken back to the water supply source unless water supply data is otherwise indicated. Calculations shall substantiate that the design area indicated is the hydraulically most demanding. Water supply curves and system requirements shall be plotted on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. A summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows shall be provided. Elevations of hydraulic reference points (nodes) shall be indicated. Documentation shall identify each pipe individually and the nodes connected thereto. The diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient shall be indicated for each pipe. For gridded

systems, calculations shall show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. Also for gridded systems, a flow diagram indicating the quantity and direction of flows shall be included. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.

#### 1.5 SUBMITTAL PREPARER'S QUALIFICATIONS

The sprinkler system submittals, including as-built drawings, shall be prepared by an individual who is either a registered professional engineer or who is certified as a Level III Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014.

#### 1.6 INSTALLER QUALIFICATIONS

The installer shall be experienced and regularly engaged in the installation of the type and complexity of system included in this project. A statement prior to submittal of any other data or drawings, that the proposed sprinkler system installer is regularly engaged in the installation of the type and complexity of system included in this project shall be provided. In addition, data identifying the location of at least three systems recently installed by the proposed installer which are comparable to the system specified shall be submitted. Contractor shall certify that each system has performed satisfactorily, in the manner intended, for a period of not less than 6 months.

#### 1.7 REGULATORY REQUIREMENTS

Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. Applicable material and installation standards referenced in Appendix A of NFPA 13 and NFPA 24 shall be considered mandatory the same as if such referenced standards were specifically listed in this specification. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. All requirements that exceed the minimum requirements of NFPA 13 shall be incorporated into the design. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

#### 1.8 DELIVERY AND STORAGE

Equipment placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust or other contaminants.

### PART 2 PRODUCTS

#### 2.1 GENERAL EQUIPMENT REQUIREMENTS

##### 2.1.1 Standard Products

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

##### 2.1.2 Requirements for Fire Protection Service

Equipment and materials shall have been tested by Underwriters Laboratories, Inc. and listed in UL-04 or approved by Factory Mutual and listed in FM P7825. Where

the terms "listed" or "approved" appear in this specification, such shall mean listed in UL-04 or FM P7825.

### 2.1.3 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate permanently affixed to the item of equipment.

## 2.2 UNDERGROUND PIPING SYSTEMS

### 2.2.1 Pipe

Piping from a point 6 inches above the floor to a point 5 feet outside the building wall shall be ductile iron with a rated working pressure of 150 psi conforming to AWWA C151, with cement mortar lining conforming to AWWA C104. Pipe shall be encased with 8 mil thick polyethylene in accordance with AWWA C105 to underside of floor slab. Piping more than 5 feet outside the building walls shall comply with Section C-02660 WATER LINES.

### 2.2.2 Fittings and Gaskets

Fittings shall be ductile iron conforming to AWWA C110. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA C111.

### 2.2.3 NOT USED

## 2.3 ABOVEGROUND PIPING SYSTEMS

Aboveground piping shall be steel or copper.

### 2.3.1 Steel Piping System

#### 2.3.1.1 Steel Pipe

Except as modified herein, steel pipe shall be black or galvanized as permitted by NFPA 13 and shall conform to applicable provisions of ASTM A 795, ASTM A 53, or ASTM A 135. Pipe in which threads or grooves are cut shall be Schedule 40 or shall be listed by Underwriter's Laboratories to have a corrosion resistance ratio (CRR) of 1.0 or greater after threads or grooves are cut. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

#### 2.3.1.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be cast iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. Steel press fittings shall be approved for fire protection systems. Galvanized fittings shall be used for piping systems or portions of piping systems utilizing galvanized piping. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings which use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.



#### 2.3.1.3 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 175 psi service and shall be the product of the same manufacturer. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A 183 and shall be cadmium plated or zinc electroplated.

#### 2.3.1.4 Flanges

Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch thick, and full face or self-centering flat ring type. Bolts shall be squarehead conforming to ASME B18.2.1 and nuts shall be hexagon type conforming to ASME B18.2.2.

#### 2.3.2 Copper Tube Systems

##### 2.3.2.1 Copper Tube

Copper tube shall conform to ASTM B 88, Types L and M.

##### 2.3.2.2 Copper Fittings

Cast copper alloy pressure fittings shall conform to ASME B16.18 and wrought copper and bronze pressure fittings shall conform to ASME B16.22.

##### 2.3.3 NOT USED

##### 2.3.4 Pipe Hangers

Hangers shall be listed in UL-04 or FM P7825 and of the type suitable for the application, construction, and pipe type and sized involved.

##### 2.3.5 Valves

##### 2.3.5.1 Control Valve and Gate Valve

Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type and shall be listed in UL-01 or FM P7825.

##### 2.3.5.2 Check Valve

Check valve 2 inches and larger shall be listed in UL-01 or FM P7825. Check valves 4 inches and larger shall be of the swing type with flanged cast iron body and flanged inspection plates, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

##### 2.3.5.3 NOT USED

#### 2.4 ALARM CHECK VALVE ASSEMBLY

Assembly shall include an alarm check valve, standard trim piping, pressure gauges, bypass, retarding chamber, testing valves, main drain, and other components as required for a fully operational system.

#### 2.5 WATER MOTOR ALARM ASSEMBLY

Assembly shall include a body housing, impeller or pelton wheel, drive shaft, striker assembly, gong, wall plate and related components necessary for complete

operation. Minimum 3/4 inch galvanized piping shall be provided between the housing and the alarm check valve. Drain piping from the body housing shall be minimum 1 inch galvanized and shall be arranged to drain to the outside of the building. Piping shall be galvanized both on the inside and outside surfaces.

## 2.6 ALARM INITIATING AND SUPERVISORY DEVICES

### 2.6.1 Sprinkler Waterflow Indicator Switch, Vane Type

Switch shall be vane type with a pipe saddle and cast aluminum housing. The electro-mechanical device shall include a flexible, low-density polyethylene paddle conforming to the inside diameter of the fire protection pipe. The device shall sense water movements and be capable of detecting a sustained flow of 10 gpm or greater. The device shall contain a retard device adjustable from 0 to 90 seconds to reduce the possibility of false alarms caused by transient flow surges. The switch shall include two SPDT (Form C) contacts, and shall be equipped with a silicone rubber gasket to assure positive water seal and a dustproof cover and gasket to seal the mechanism from dirt and moisture.

### 2.6.2 Sprinkler Pressure (Waterflow) Alarm Switch

Pressure switch shall include a metal housing with a neoprene diaphragm, SPDT snap action switches and a 1/2 inch NPT male pipe thread. The switch shall have a maximum service pressure rating of 175 psi. There shall be two SPDT (Form C) contacts factory adjusted to operate at 4 to 8 psi. The switch shall be capable of being mounted in any position in the alarm line trim piping of the alarm check valve.

### 2.6.3 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

## 2.7 FIRE DEPARTMENT CONNECTION

Fire department connection shall be projecting or flush type with cast brass body, matching wall escutcheon lettered "Auto Spkr" with a polished brass finish. The connection shall have two inlets with individual self-closing clappers, caps with drip drains and chains. Female inlets shall have 2-1/2 inch diameter American National Fire Hose Connection Screw Threads (NH) per NFPA 1963.

## 2.8 SPRINKLERS

Sprinklers shall be used in accordance with their listed spacing limitations. Temperature classification shall be as indicated. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13.

### 2.8.1 Upright Sprinkler

Upright sprinkler shall be brass chrome-plated or white enamel and shall have a nominal 1/2 inch or 17/32 inch orifice.

### 2.8.2 Pendent Sprinkler

Pendent sprinkler shall be of the fusible strut or glass bulb, semi-recessed type with nominal 1/2 inch or 17/32 inch orifice. Pendent sprinklers shall have a polished chrome or white enamel finish.

2.8.3 thru 2.8.7 NOT USED

## 2.9 DISINFECTING MATERIALS

### 2.9.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

### 2.9.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

## 2.10 ACCESSORIES

### 2.10.1 Sprinkler Cabinet

Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal or plastic cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.

### 2.10.2 Pendent Sprinkler Escutcheon

Escutcheon shall be one-piece metallic type with a depth of less than 3/4 inch and suitable for installation on pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler heads.

### 2.10.3 Pipe Escutcheon

Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or set screw.

### 2.10.4 NOT USED

### 2.10.5 Identification Sign

Valve identification sign shall be minimum 6 inches wide x 2 inches high with enamel baked finish on minimum 18 gauge steel or 0.024 inch aluminum with red letters on a white background or white letters on red background. Wording of sign shall include, but not be limited to "main drain," "auxiliary drain," "inspector's test," "alarm test," "alarm line," and similar wording as required to identify operational components.

### 2.11 NOT USED

## 2.12 BACKFLOW PREVENTERS

Reduced pressure principle backflow preventers shall be tested, approved, and listed in accordance with FCCHR-01 and shall conform to ASSE 1013 and be approved for use by the State of Tennessee.

## PART 3 EXECUTION

### 3.1 INSTALLATION REQUIREMENTS

The installation shall be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein.

### 3.2 ABOVEGROUND PIPING INSTALLATION

Piping shall be run straight and bear evenly on hangers and supports.

#### 3.2.1 Protection of Piping Against Earthquake Damage

The system piping shall be protected against damage from earthquakes. Seismic protection of the piping system shall be provided in accordance with NFPA 13 and Appendix A, with the exception that the "Earthquake Zones" map of Appendix A shall not apply to this project. Seismic protection shall include flexible couplings, sway bracing, seismic separation assemblies where piping crosses building seismic separation joints, and other features as required in NFPA 13 for protection of piping against damage from earthquakes. Branch lines shall be equipped with sway braces at the end sprinkler head and at intervals not exceeding 30 ft.

#### 3.2.2 Piping in Exposed Areas

Exposed piping shall be installed so as not to diminish exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

#### 3.2.3 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

#### 3.2.4 Pendent Sprinklers

Drop nipples to pendent sprinklers shall consist of minimum 1 inch pipe with a reducing coupling into which the sprinkler shall be threaded. Hangers shall be provided on arm-overs to drop nipples supplying pendent sprinklers when the arm-over exceeds 12 inches. Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 1 inch below the underside of the ceiling. On pendent sprinklers installed below suspended or dropped ceilings, the distance from the sprinkler deflector to the underside of the ceiling shall not exceed 4 inches. Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area.

##### 3.2.4.1 Pendent Sprinkler Locations

Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches from ceiling grid.

#### 3.2.5 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 30 inches in length shall be individually supported.

#### 3.2.6 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the

Contractor's fabrication shop, not at the project construction site. Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings and fittings shall be from the same manufacturer.

#### 3.2.7 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2 inch.

#### 3.2.8 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes pass through fire walls, fire partitions, or floors, a fire seal shall be placed between the pipe and sleeve in accordance with Section C-07270 FIRESTOPPING. In penetrations which are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement which will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

#### 3.2.9 Escutcheons

Escutcheons shall be provided for pipe penetration of ceilings and walls in finished areas. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

#### 3.2.10 Inspector's Test Connection

Unless otherwise indicated, test connection shall consist of 1 inch pipe connected to the remote branch line; a test valve located approximately 7 feet above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test." The discharge orifice shall be located outside the building wall directed so as not to cause damage to adjacent construction or landscaping during full flow discharge.

#### 3.2.11 Drains

Main drain piping shall be provided to discharge at a safe point outside the building. Auxiliary drains shall be provided as required by NFPA 13 except that drain valves shall be used where drain plugs are otherwise permitted. Where branch lines terminate at low points and form trapped sections, such branch lines shall be manifolded to a common drain line.

### 3.2.12 Installation of Fire Department Connection

Connection shall be mounted on the exterior wall approximately 3 feet above finished grade. The piping between the connection and the check valve shall be provided with an automatic drip in accordance with NFPA 13 and arranged to drain to the outside.

### 3.2.13 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

## 3.3 UNDERGROUND PIPING INSTALLATION

The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be 30 inches. The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 6 inches above the finished floor. A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block shall be provided at the elbow where the pipe turns up toward the floor. In addition, joints shall be anchored in accordance with NFPA 24 using pipe clamps and steel rods from the elbow to the flange above the floor and from the elbow to a pipe clamp in the horizontal run of pipe. Buried steel components shall be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 5 feet outside the building walls shall meet the requirements of Section C-02660 WATER LINES.

## 3.4 EARTHWORK

Earthwork shall be performed in accordance with applicable provisions of Section C-02221 EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS.

## 3.5 ELECTRICAL WORK

Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section C-16721 FIRE DETECTION AND ALARM SYSTEM. All wiring for supervisory and alarm circuits shall be #14 AWG solid copper installed in metallic tubing or conduit. Wiring color code shall remain uniform throughout the system.

## 3.6 STERILIZATION

After system components have been installed and pressure tested, each portion of the completed system shall be sterilized. After pressure tests have been made, the portion to be sterilized shall be thoroughly flushed with water until all entrained dirt and other foreign materials have been removed before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the sprinkler piping at a constant rate of 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or liquid chlorine injected into the system through a solution-fed chlorinator and booster pump, shall be used. Chlorination application shall continue until the entire system is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system shall be opened and closed several times to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. The system shall be then flushed with clean

water until the residual chlorine is reduced to less than one part per million. Samples of water in properly sterilized containers for bacterial examination will be taken from several system locations which are approved by the Contracting Officer. Samples shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA-10062JV. The testing method shall be either the multiple-tube fermentation technique or the membrane-filter technique. The sterilization shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

### 3.7 FIELD PAINTING AND FINISHING

Field painting and finishing are specified in Section C-09900 PAINTING, GENERAL.

### 3.8 PRELIMINARY TESTS

The system, including the underground water mains, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, the Contractor shall complete certificates as specified in paragraph SUBMITTALS.

#### 3.8.1 Underground Piping

##### 3.8.1.1 Flushing

Underground piping shall be flushed in accordance with NFPA 24. This includes the requirement to flush the lead-in connection to the fire protection system at a flow rate not less than the calculated maximum water demand rate of the system.

##### 3.8.1.2 Hydrostatic Testing

New underground piping shall be hydrostatically tested in accordance with NFPA 24. The allowable leakage shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 2 quarts per hour per 100 gaskets or joints, regardless of pipe diameter.

#### 3.8.2 Aboveground Piping

##### 3.8.2.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 200 psi or 50 psi in excess of maximum system operating pressure and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

##### 3.8.3 Testing of Alarm Devices

Each alarm switch shall be tested by flowing water through the inspector's test connection. Each water-operated alarm devices shall be tested to verify proper operation.

#### 3.8.4 Main Drain Flow Test

Following flushing of the underground piping, a main drain test shall be made to verify the adequacy of the water supply. Static and residual pressures shall be recorded on the certificate specified in paragraph SUBMITTALS. In addition, a main drain test shall be conducted each time after a main control valve is shut and opened.

#### 3.9 FINAL ACCEPTANCE TEST

A technician employed by the installing Contractor shall be present for the final tests and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. In addition, the representative shall have available copies of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received.

-- End of Section --



SECTION C-15400

PLUMBING, GENERAL PURPOSE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 1010 (1994) Drinking-Fountains and Self-Contained,  
Mechanically-Refrigerated Drinking-Water Coolers

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.10.1 (1993; Z21.10.1a; Z21.10.1b; Z21.10.1c) Gas Water  
Heaters Vol. I: Storage Water Heaters with Input Ratings  
of 75,000 Btu Per Hour or Less

ANSI Z21.10.3 (1993; Z21.10.3a; Z21.10.3b) Gas Water Heaters Vol.  
III: Storage, with Input Ratings Above 75,000 Btu Per  
Hour, Circulating and Instantaneous Water Heaters

ANSI Z21.22 (1986; Z21.22a) Relief Valves and Automatic Gas Shutoff  
Devices for Hot Water Supply Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47 (1990) Ferritic Malleable Iron Castings

ASTM A 53 (1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated  
Welded and Seamless

ASTM A 74 (1996) Cast Iron Soil Pipe and Fittings

ASTM A 105 (1996) Forgings, Carbon Steel, for Piping Components

ASTM A 183 (1983; R 1990) Carbon Steel Track Bolts and Nuts

ASTM A 193 (1996) Alloy-Steel and Stainless Steel Bolting  
Materials for High-Temperature Service

ASTM A 515 (1992) Pressure Vessel Plates, Carbon Steel, for  
Intermediate- and Higher-Temperature Service

ASTM A 516 (1990) Pressure Vessel Plates, Carbon Steel, for  
Moderate- and Lower-Temperature Service

ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM A 733	(1993) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 888	(1994) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications
ASTM B 32	(1995b) Solder Metal
ASTM B 42	(1993) Seamless Copper Pipe, Standard Sizes
ASTM B 75	(1993) Seamless Copper Tube
ASTM B 88	(1996) Seamless Copper Water Tube
ASTM B 152	(1994) Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B 306	(1996) Copper Drainage Tube (DWV)
ASTM B 370	(1992) Copper Sheet and Strip for Building Construction
ASTM B 641	(1993) Seamless and Welded Copper Distribution Tube (Type D)
ASTM B 813	(1993) Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
ASTM B 828	(1992) Making Capillary Joints by Soldering of Copper and Copper-Alloy Tube and Fittings
ASTM C 564	(1995) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 920	(1994) Elastomeric Joint Sealants
ASTM D 1785	(1994) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2235	(1993a) Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2000	(1996) Rubber Products in Automotive Applications
ASTM D 2241	(1994) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

ASTM D 2447	(1993) Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
ASTM D 2466	(1994a) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1994) Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(1993) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2665	(1995) Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2672	(1993; R 1995) Joints for IPS PVC Pipe Using Solvent Cement
ASTM D 2683	(1993) Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D 2737	(1993) Polyethylene (PE) Plastic Tubing
ASTM D 2822	(1991) Asphalt Roof Cement
ASTM D 2846	(1995) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
ASTM D 2855	(1993) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2996	(1995) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 3035	(1993) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter
ASTM D 3122	(1993) Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings
ASTM D 3138	(1993) Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Non-Pressure Piping Components.
ASTM D 3139	(1989; R1995) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1992) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

ASTM D 3261	(1993) Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D3308	(1991a) PTFE Resin Skived Tape
ASTM D 3311	(1994) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM E 1	(1995) ASTM Thermometers
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM F 409	(1995) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F 438	(1993) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F 439	(1993a) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 441	(1995) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F 442	(1994) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
ASTM F 477	(1995) Elastomeric Seals (Gaskets) for Joining Plastic Pipe (SDR-PR)
ASTM F 493	(1993a) Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
ASTM F 891	(1993a) Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1	(1989; 90.1b; 90.1c; 90.1d; 90.1e; 90.1g; 90.1i-o) Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings
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AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.1.2	(1991) Air Gaps in Plumbing Systems
ASME A112.6.1M	(1988) Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.18.1M	(1996) Plumbing Fixture Fittings
ASME A112.19.1M	(1994) Enameled Cast Iron Plumbing Fixtures
ASME A112.19.2M	(1995; Errata) Vitreous China Plumbing Fixtures
ASME A112.21.1M	(1991) Floor Drains

ASME A112.36.2M	(1991) Cleanouts
ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.3	(1992) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	(1992) Cast Iron Threaded Fittings Class 125 and 250
ASME B16.5	(1988; Errata Oct 88; B16.5a) Pipe Flanges and Flanged Fittings
ASME B16.12	(1991) Cast Iron Threaded Drainage Fittings
ASME B16.15	(1985; R 1994) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(1992; Errata Jan 1994) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.24	(1991; Errata) Cast Copper Alloy Pipe Flanges, Class 150, 300, 400, 600, 900, 1500 and 2500, and Flanged Fittings, Class 150 and 300
ASME B16.29	(1994) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.34	(1988) Valves - Flanged, Threaded, and Welding End
ASME B16.39	(1986; R 1994) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B31.1	(1995) Power Piping
ASME B31.5	(1992; B 31.5a) Refrigeration Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element

ASME BPV VIII Div 1	(1992; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME BPV IX	(1995; Addenda Dec 1995,) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME CSD-1	(1995) Controls and Safety Devices for Automatically Fired Boilers

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(1990) Pipe Applied Atmospheric Type Vacuum Breakers
ASSE 1002	(1964; Rev thru Apr 1986) Water Closet Flush Tank Ball Locks
ASSE 1003	(1964; Rev thru Oct 1993; Errata Dec 1993) Water Pressure Reducing Valves for Domestic Water Supply Systems
ASSE 1005	(1993) Water Heater Drain Valves - 3/4-Inch Iron Pipe Size
ASSE 1011	(1995) Hose Connection Vacuum Breakers
ASSE 1012	(1995) Backflow Preventers with Intermediate Atmospheric Vent
ASSE 1013	(1971; Rev thru Oct 1993) Reduced Pressure Principle Backflow Preventers
ASSE 1037	(1986; Rev thru Mar 1990) Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures/F

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA-01	(1995) Standard Methods for the Examination of Water and Wastewater
AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA C105	(1993) Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids

AWWA C203 (1991) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

AWWA C606 (1987) Grooved and Shouldered Joints

AWWA C700 (1995) Cold-water Meters - Displacement Type, Bronze Main Case

AWWA M20 (1973) Manual: Water Chlorination Principles and Practices

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8 (1992) Filler Metals for Brazing and Braze Welding

AWS B2.2 (1991) Brazing Procedure and Performance Qualification

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301 (1995) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

CISPI HSN-85 (1985) Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings

CODE OF FEDERAL REGULATIONS (CFR)

10 CFR Part 430 Energy Conservation Program for Consumer Products

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-238 (Rev B) Seat, Water Closet

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA-02 (1995) Copper Tube Handbook

CDA 404/O-RR (1992) Copper Tube for Plumbing, Heating, Air Conditioning and Refrigeration

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCHR)

FCCHR-01 (1993) Manual of Cross-Connection Control

HYDRAULIC INSTITUTE (HI)

HI-01 (1983) Standards for Centrifugal, Rotary & Reciprocating Pumps

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1993) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-44	(1996) Steel Pipe Line Flanges
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-67	(1995) Butterfly Valves
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1990) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1990) Cast Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72	(1992) Ball Valves with Flanged or Butt-welding Ends for General Service
MSS SP-73	(1991) Brazing Joints for Copper and Copper Alloy Pressure Fittings
MSS SP-78	(1987; R 1992) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-83	(1995) Steel Pipe Unions Socket-Welding and Threaded
MSS SP-84	(1990) Valves - Socket Welding and Threaded Ends
MSS SP-85	(1994) Cast Iron Globe & Angle Valves Flanged and Threaded Ends
MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ASSOCIATION OF PLUMBING-HEATING-COOLING CONTRACTORS  
(NAPHCC)

NAPHCC-01	(1996) National Standard Plumbing Code (Non-Illustrated Edition)
NAPHCC-02	(1993) National Standard Plumbing Code Illustrated Edition

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54 (1992) National Fuel Gas Code

NFPA 90A (1993) Installation of Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF Std 14 (1965; Rev Nov 1990) Plastics Piping Components and Related Materials

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA-01 (1991) Plastic Pipe in Fire Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201 (1992) Water Hammer Arresters

SAE J1508 (1993) Hose Clamps

1.2 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening.

1.3 PERFORMANCE REQUIREMENTS

1.3.1 Welding

Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record. Structural members shall be welded in accordance with Section C-05055 WELDING, STRUCTURAL.

1.3.2 NOT USED

1.4 ELECTRICAL WORK

Motors, motor controllers and motor efficiencies shall conform to the requirements of Section C-16415 ELECTRICAL WORK, INTERIOR. Electrical motor-driven equipment specified herein shall be provided complete with motors. Equipment shall be rated at 60 Hz, single phase, ac unless otherwise indicated. Where a motor controller is not provided in a motor-control center on the electrical drawings, a motor controller shall be provided with the mechanical equipment. Motor controllers shall be provided complete with properly sized thermal-overload protection in each ungrounded conductor, auxiliary contact, and other equipment, at the specified capacity, and including an allowable service factor.

## 1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

### SD-01 Data

Welding; GA.

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

### SD-04 Drawings

Plumbing System; GA.

Detail drawings consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operations of each system. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

Electrical Schematics; FIO.

Complete electrical schematic lineless or full line interconnection and connection diagram for each piece of mechanical equipment having more than one automatic or manual electrical control device.

### SD-06 Instructions

Plumbing System; FIO.

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

### SD-09 Reports

Tests, Flushing and Sterilization; FIO.

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Backflow Prevention Assembly Tests; FIO

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

## SD-13 Certificates

Materials and Equipment; GA.

Where materials or equipment are specified to comply with requirements of AGA, or ASME, proof of such compliance. The label or listing of the specified agency will be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency. Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

Bolts; FIO.

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements. The certification shall include illustrations of product-required markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification.

## SD-19 Operation and Maintenance Manuals

Plumbing System; GA.

Six copies of the operation manual outlining the step-by-step procedures required for system startup, operation and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of the maintenance manual listing routine maintenance procedures, possible breakdowns and repairs. The manual shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed.

### 1.6 REGULATORY REQUIREMENTS

#### 1.6.1 Plumbing

Plumbing work shall be in accordance with NAPHCC-01 and State of Tennessee Requirements.

### 1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF Std 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing lead shall not

be used in any potable water system. Hubless cast-iron soil pipe shall not be installed under concrete floor slabs.

#### 2.1.1 Pipe Joint Materials

Grooved pipe shall not be used under ground. Joints and gasket materials shall conform to the following:

- a. Coupling for Cast-Iron Pipe: ASTM A 74, AWWA C606.
- b. Coupling for Steel Pipe: AWWA C606.
- c. Couplings for Grooved Pipe: Ductile Iron ASTM A 536 (Grade 65-45-12) or Malleable Iron ASTM A 47, Grade 32510. Copper ASTM A 536.
- d. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.
- e. Neoprene Gaskets for Hub and Cast-Iron Pipe and Fittings: CISPI HSN-85.
- f. Brazing Material: Brazing material shall conform to AWS A5.8, BCuP-5.
- g. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides. Silver brazing materials shall be in accordance with AWS A5.8.
- h. Solder Material: Solder metal shall conform to ASTM B 32 95-5 tin-antimony.
- i. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.
- j. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe, ASTM D3308.
- k. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings: ASTM C 564.
- l. Rubber Gaskets for Grooved Pipe: ASTM D 2000, maximum temperature 230 degrees F.
- m. Flexible Elastomeric Seals: ASTM D 3139, ASTM D 3212 or ASTM F 477.
- n. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A 183.
- o. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: ASTM D 3138.
- p. Plastic Solvent Cement for ABS Plastic Pipe: ASTM D 2235.
- q. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D 2564 and ASTM D 2855.
- r. Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F 493.
- s. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc. shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105. Blind flange material shall conform to ASTM A 516 cold service and ASTM A 515 for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193.
- t. Plastic Solvent Cement for Styrene Rubber Plastic Pipe: ASTM D 3122 .

#### 2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

- a. Water Hammer Arrestor: PDI WH 201.
- b. Copper, Sheet and Strip for Building Construction: ASTM B 370.
- c. Asphalt Roof Cement: ASTM D 2822.
- d. Hose Clamps: SAE J1508.
- e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.
- f. Metallic Cleanouts: ASME A112.36.2M.

g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon was material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.

h. NOT USED.

i. Hypochlorites: AWWA B300.

j. Liquid Chlorine: AWWA B301.

k. Polyethylene Encasement for Ductile-Iron Piping: AWWA C105.

l. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.1.

m. Thermometers: ASTM E1.

### 2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section C-15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

## 2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

## 2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16. 34
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Vacuum Relief Valves	ASSE 1001

Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASSE 1005
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22
Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers	ASME CSD-1 Safety Code No., Part CW, Article 5

#### 2.3.1 NOT USED

#### 2.3.2 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 3/4 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection. Faucet handle shall be securely attached to stem.

#### 2.3.3 Wall Hydrants

Wall hydrants with vacuum-breaker backflow preventer shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 3/4 inch exposed hose thread on spout and 3/4 inch male pipe thread on inlet.

#### 2.3.4 NOT USED

#### 2.3.5 Yard Hydrants

Yard box or post hydrants shall have valve housings located below frost lines. Water from the casing shall not be drained after valve is shut off. Hydrant shall be bronze with cast-iron box or casing guard. "T" handle key shall be provided.

#### 2.3.6 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22. Relief valves for systems where the maximum rate of heat input is less than 200,000 Btuh shall have 3/4 inch minimum inlets, and 3/4 inch outlets. Relief valves for systems where the maximum rate of heat input is greater than 200,000 Btuh shall have 1 inch minimum inlets, and 1 inch outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

### 2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with NAPHCC-01. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body

shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years. Plastic in contact with hot water shall be suitable for 180 degrees F water temperature. Plumbing fixtures shall be as indicated in paragraph PLUMBING FIXTURE SCHEDULE.

2.4.1 NOT USED

2.4.2 NOT USED

## 2.5 BACKFLOW PREVENTERS

Backflow preventers shall be approved and listed by the Foundation For Cross-Connection Control and Hydraulic Research and approved by the State of Tennessee. Reduced pressure principle assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCHR-01. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Air gaps in plumbing systems shall conform to ASME A112.1.2.

## 2.6 DRAINS

### 2.6.1 Floor and Shower Drains

Floor and shower drains shall consist of a galvanized cast-iron body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of square grate and threaded collar. Floor drains shall be cast iron. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded or caulked connection. In lieu of a caulked joint between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C 564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to ASME A112.21.1M.

2.6.1.1 NOT USED

2.6.1.2 NOT USED

#### 2.6.2 Area Drains

Area drains shall consist of a body, integral seepage pan, and nontilting slotted grate. Drains shall be of double drainage pattern suitable for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drain pipe. Membrane or flashing clamping device shall be provided when required. Drains shall be cast iron with manufacturer's standard coating. Drains shall be circular with 8 inch (nom.) diameter grate and provided with bottom outlet suitable for inside caulked connection, unless otherwise indicated. Drains shall be provided with separate cast-iron "P" traps.

2.6.3 NOT USED

2.6.4 NOT USED

2.6.5 NOT USED

#### 2.6.6 Sight Drains

Sight drains shall consist of a body, integral seepage pan, and nontilting slotted grate. Drains shall be of double drainage pattern suitable for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drain pipe. Membrane or flashing clamping device shall be provided when required. Drains shall be cast iron with manufacturer's standard coating. Drains shall be circular with 8 inch (nom.) diameter grate and provided with bottom outlet suitable for inside caulked connection, unless otherwise indicated. Drains shall be provided with separate cast-iron "P" traps. The funnel shall be securely mounted over an opening in the center of the strainer. Minimum dimensions shall be as follows:

Area of strainer	50 square inches
Height of funnel	3-3/4 inches
Diameter of lower portion of funnel	2 inches
Diameter of upper portion of funnel	4 inches

2.6.7 NOT USED

2.6.8. Drain types shall be as indicated on the drawings.

2.7 NOT USED

#### 2.8 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F 409 or copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2



inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

## 2.9 NOT USED

## 2.10 WATER HEATER

Water heater types and capacities shall be as indicated. Each water heater shall have controls adjustable from 120 to 150 degrees F and shall be set at 140 degrees F. The thermal efficiencies and stand by heat losses shall conform to ASHRAE 90.1.

### 2.10.1 Automatic Storage Type

Heaters shall be insulated glass lined steel tank with enamelled steel jacket, complete with anode rod, control system, temperature gauge, and pressure gauge, and shall have ASME rated combination pressure and temperature relief valve.

### 2.10.2 NOT USED

### 2.10.3 Gas-Fired Type

Gas-fired water heaters shall conform to ANSI Z21.10.1 when input is 75,000 Btu per hour or less, and ANSI Z21.10.3 for heaters with input greater than 75,000 Btu per hour. Gas burner for unit greater than 75,000 Btu per hour input shall have electronic spark ignition. Each water heater shall have automatic gas valve and pressure regulators.

### 2.10.4 NOT USED

### 2.10.5 NOT USED

### 2.10.6 NOT USED

### 2.10.7 NOT USED

## 2.11 NOT USED

## 2.12 NOT USED

## 2.13 NOT USED

## 2.14 COMPRESSED AIR SYSTEM

### 2.14.1 Air Compressors

Air compressor units shall be factory-packaged assemblies, including 3 phase, 208 volt motor controls, switches, wiring, accessories, and motor controllers, in a NEMA 250, Type 4 enclosure. Tank-mounted air compressors shall be manufactured to comply with UL listing requirements. Air compressors shall have manufacturer's name and address, together with trade name, and catalog number on a nameplate securely attached to the equipment. Each compressor shall start and stop automatically at upper and lower pressure limits of the system. Guards shall shield exposed moving parts. Each duplex compressor system shall be provided with automatic alternation system. Each compressor motor shall be

provided with an across-the-line-type magnetic controller, complete with low-voltage release. An intake air filter and silencer shall be provided with each compressor system. Aftercooler and moisture separator shall be installed between compressors and air receiver to remove moisture and oil condensates before the air enters the receiver. Aftercoolers shall be air-cooled. The air shall pass through a sufficient number of tubes to affect cooling. Tubes shall be sized to give maximum heat transfer. Cooling capacity of the aftercooler shall be sized for the total capacity of the compressors. Means shall be provided for draining condensed moisture from the receiver by an inverted bucket type trap utilizing stainless steel internal components. Capacities of air compressors and receivers shall be as indicated.

#### 2.14.2 Lubricated Compressors

Compressors shall be two-stage, V-belt drive, capable of operating continuously against their designed discharge pressure, and shall operate at a speed not in excess of 1800 rpm. Compressors shall have the capacity and discharge pressure indicated. Compressors shall be assembled complete for receiver mounting. The compressor main bearings shall be either roller or ball. The discharge passage of the high pressure air shall be piped to the air receiver with a copper pipe or tubing. A pressure gauge calibrated to 250 psi and equipped with a gauge cock and pulsation dampener shall be furnished for installation adjacent to pressure switches.

#### 2.14.3 Air Receivers

Receivers shall be designed for 200 psi working pressure. Receivers shall be factory air tested to 1-1/2 times the working pressure. Receivers shall be equipped with safety relief valves and accessories, including pressure gauges and automatic and manual drains. The outside of air receivers may be galvanized or supplied with commercial enamel finish. Receivers shall be designed and constructed in accordance with ASME BPV VIII Div 1 and shall have the design working pressures specified herein. A display of the ASME seal on the receiver or a certified test report from an approved independent testing laboratory indicating conformance to the ASME Code shall be provided.

#### 2.14.4 Intake Air Supply Filter

Dry type air filter shall be provided having a collection efficiency of 99 percent of particles larger than 10 microns. Filter body and media shall withstand a maximum 125 psi, capacity as required for system.

#### 2.14.5 Pressure Regulators

The air system shall be provided with the necessary regulator valves to maintain the desired pressure for the installed equipment. Regulators shall be designed for a maximum inlet pressure of 125 psi and a maximum temperature of 200 degrees F. Regulators shall be single-seated, pilot-operated with valve plug, bronze body and trim or equal, and threaded connections. The regulator valve shall include a pressure gauge and shall be provided with an adjustment screw for adjusting the pressure differential from 0 to 125 psi. Regulator shall be sized as required for system.

#### 2.15 DOMESTIC WATER SERVICE METER

Cold water meter shall be of the positive displacement type conforming to AWWA C700. Meter register may be round or straight reading type. Meter shall be provided with a pulse generator, remote readout register and all necessary wiring and accessories.

## 2.16 BULK LUBRICATION SYSTEM

The following equipment as listed below and indicated shall be furnished and installed so as to provide a complete and functional lubrication system. Installation shall be per manufacturer's recommendations and instructions.

### 2.16.1 Reel Case and Hose Assembly, Transmission Oil

Reel case and hose assembly, transmission oil, shall be rack mounted heavy duty hose and reel assembly designed to handle low pressure transmission oil. Hose reel and base construction assembly shall consist of a spring retracted hose reel with latching mechanism, double hub hanger, antileak hub seal, 12-gage steel base and support brackets, 12-gage double arm adjustable hose guide with 4 steel hose guide rollers. Provide flexible medium pressure inlet hose, 1/2 inch I.D. and 50 feet long, with adjustable ball stop clamp, trigger operated low pressure high volume control valve with 16 quart totalizing meter and extension nondrip nozzle. Provide shutoff valve at reel.

### 2.16.2 Reel Case and Hose Assembly, Air

Reel case and hose assembly, air, shall be rack mounted heavy duty hose and reel assembly designed to handle low pressure air. Hose reel and base construction assembly shall consist of a spring retracted hose reel with latching mechanism, double hub hanger, antileak hub seal, 12-gage steel base and support brackets, 12-gage double arm adjustable hose guide with 4 steel hose guide rollers. Provide flexible medium pressure inlet hose, 1/2 inch I.D. and 14 inches long with swivel union, flexible medium pressure outlet hose, 1/2 inch I.D. and 50 feet long, with adjustable ball stop clamp, air line coupler and snap-in air chuck assembly.

### 2.16.3 Reel Case and Hose Assembly, Motor Oil

Reel case and hose assembly, motor oil, shall be rack mounted heavy duty hose and reel assembly designed to handle low pressure air. Hose reel and base construction assembly shall consist of a spring retracted hose reel with latching mechanism, double hub hangar, antileak hub seal, 12-gage steel base and support brackets, 12-gage double arm adjustable hose guide with 4 steel 1/2 inch, I.D. and 14 inches long with swivel union, flexible medium pressure, outlet hose 1/2 inch I.D. and 50 feet long, with adjustable ball stop clamp, trigger operated low pressure high volume control valve with 16 quart totalizing meter and extension nondrip nozzle. Provide shutoff valve at reel.

### 2.16.4 Reel Case and Hose Assembly, Chassis Lube

Reel case and hose assembly, chassis lube, shall be rack mounted heavy duty hose and reel assembly designed for high pressure lubricants. Assembly shall consist of a spring retracted hose reel with latching mechanism, double hub hanger, antileak hub seal, 12-gage steel base and support brackets, 12-gage double arm adjustable hose guide support with 4 reel hose guide rollers, flexible high pressure inlet hose 1/4 inch I.D. and 14 inches long with swivel union, flexible high pressure outlet hose 1/4 inch I.D. and 50 feet long with adjustable ball stop clamp, trigger operated high pressure control valve with plastic shielded grip, 360 degree swiveling adaptor and hydraulic coupler fitting for lubricant dispensing. Provide shutoff valve at reel.

### 2.16.5 Reel Case and Hose Assembly, Gear Oil

Reel case and hose assembly, gear oil, shall be rack mounted heavy duty hose and reel assembly designed for low pressure lubricants. Assembly shall consist of

a spring retracted hose reel with latching mechanism, double hub hanger, antileak hub seal, 12-gage steel base and support brackets, 12-gage double arm adjustable hose guide with 4 steel hose guide rollers, flexible medium pressure inlet hose, 1/2 inch I.D. and 14 inches long with swivel union, flexible medium pressure outlet hose, 1/2 inch I.D. and 50 feet long, with adjustable ball stop clamp, trigger operated low pressure, high volume control valve with 8 pint totalizing meter and 6 inch long tube with nondrip nozzle. Provide shutoff valve at reel.

#### 2.16.6 Reel Case and Hose Assembly, Antifreeze

Reel case and hose assembly, antifreeze, shall be rack mounted heavy duty hose and reel assembly designed to handle low pressure antifreeze. Hose reel and base construction assembly shall consist of a spring retracted hose reel with latching mechanism, double hub hanger, antileak hub seal, 12-gage steel base and support brackets, 12-gage double arm adjustable hose guide with 4 steel hose guide rollers. Provide flexible medium pressure inlet hose, 1/2 in I.D. and 14 inches long with swivel unions, flexible medium pressure outlet hose 1/2 inch I.D. and 50 feet long, with adjustable ball stop clamp, trigger operated low pressure high volume control valve with 16 quart totalizing meter and extension nondrip nozzle. Provide shutoff valve at reel. All parts shall be corrosion resistant.

2.16.7 Reel assemblies shall be as indicated on the drawings. Provide for top or wall amounting as indicated. All reels shall be open-type.

#### 2.16.8 Pump and Drum Mounting Assembly, Motor Oil

Pump and drum mounting assembly, motor oil, shall be automotive lubricant type air driven pump assembly, designed to pump motor oil from bulk drum containers to remote dispensing equipment. Motor shall be heavy duty compressed air driven reciprocating action motor with 3-inch stroke, 5 to 1 pump ration and intermittent duty rating of 7 gpm. Unit shall be sized for 400 lb. drum and designed for hung mounting. Provide hung mounting adaptor 6 feet of 1/2 inch I.D. air supply hose and 6 feet of 1/2 inch I.D. fluid hose, complete with all fittings.

#### 2.16.9 Pump and Drum Cover Assembly, Chassis Lube

Pump and drum cover assembly, chassis lube, shall be automotive lubricant type air driven pump assembly designed to pump chassis lube from bulk drum containers to remote dispensing equipment. Motor shall be heavy duty compressed air driven reciprocating action motor with 4-inch stroke, 46 to 1 pump ratio and intermittent duty rating of 1 gpm. Unit shall be sized for 400-pound drum and top mounted on a drum cover. Provide 6 feet of 1/2 inch I.D. air supply hose and 6 feet of 3/8 inch I.D. high pressure fluid hose, complete with all fittings. Provide follower plate sized for drum and pump.

#### 2.16.10 Pump and Drum Cover Assembly, Gear Oil

Pump and drum cover assembly, gear oil, shall be automotive lubricant type air driven pump assembly designed to pump gear oil from bulk drum containers to remote dispensing equipment. Motor shall be heavy duty compressed air drive reciprocating action motor with 4-inch stroke, 10 to 1 pump ration and intermittent duty rating of 7.5 gpm. Unit shall be size for 400-pound drum and be wall mounted. Provide e 6 feet of 1/2 inch I.D. air supply hose and 6 feet of 3/4 inch I.D. fluid hose, complete with all fittings. Pump shall include suction tube kit, mounting bracket and pump stub.

#### 2.16.11 Pump and Drum Mounting Assembly, Antifreeze Unit

Pump and drum mounting assembly, antifreeze unit, shall be air driven pump assembly, designed to pump from bulk drum containers to remote dispensing equipment. Motor shall be heavy duty compressed air driven reciprocating action motor with 3-inch stroke, 5 to 1 pump ratio and intermittent duty rating of 7 gpm. Unit shall be sized for 400-pound drum and designed for hung mounting. Provide hung mounting adaptor, 6 feet of 1/2 inch I.D. air supply hose and 6 feet of 1/2 inch I.D. fluid hose, complete with all fittings. All parts shall be corrosion resistant and have teflon packing.

#### 2.16.12 Pump and Drum Mounting Assembly, Transmission Oil

Pump and drum mounting assembly, transmission oil, shall be air driven pump assembly, designed to pump from bulk drum containers to remote dispensing equipment. Motor shall be heavy duty compressed air driven reciprocating action motor with 3-inch stroke, 5 to 1 pump ratio and intermittent duty rating of 7 gpm. Unit shall be sized for 400-pound drum and designed for hung mounting. Provide hung mounting adaptor, 6 feet of 1/2 inch I.D. air supply hose and 6 feet of 1/2 inch I.D. fluid hose, complete with all fittings.

### PART 3 EXECUTION

#### 3.1 GENERAL INSTALLATION REQUIREMENTS

Hubless cast-iron pipe shall not be installed under concrete floor slabs. Piping located in air plenums shall conform to NFPA 90A requirements. Unprotected plastic pipe shall not be installed in air plenum. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA-01. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the average local frost depth. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means.

##### 3.1.1 Water Pipe, Fittings, and Connections

###### 3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

###### 3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment

as a result of cutting shall be repaired by mechanics skilled in the trade involved.

#### 3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

#### 3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific excepted installation practice. Change in direction shall be made with fittings. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

#### 3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and full port ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

#### 3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets, changes in direction, etc., where indicated and/or required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

#### 3.1.1.7 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to PDI WH 201. Vertical capped pipe columns will not be permitted.

#### 3.1.2 Compressed Air Piping (Non-Oil Free)

Compressed air piping shall be installed as specified for water piping and suitable for 125 psig working pressure. Compressed air piping shall have supply lines and discharge terminals legibly and permanently marked at both ends with the name of the system and the direction of flow.

#### 3.1.3 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

##### 3.1.3.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

##### 3.1.3.2 Mechanical Couplings

Grooved mechanical joints shall be prepared according to the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, or narrow-land micrometer. Groove width and dimension of groove from end of the pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

##### 3.1.3.3 Union and Flanged

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

##### 3.1.3.4 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

##### 3.1.3.5 Copper Tube and Pipe

The tube or fittings shall not be annealed when making connections. Connections shall be made with a multiflame torch.

a. Brazed. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA -02 with flux and are acceptable for line sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-

silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.

b. Soldered. Soldered joints shall be made with flux and are only acceptable for lines 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA -02.

c. Copper Tube Extracted Joint. An extracted mechanical joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. Branch tube shall be notched for proper penetration into fitting to ensure a free flow joint. Extracted joints shall be brazed in accordance with NAPHCC-01 using B-Cup series filler metal in accordance with MSS SP-73. Soldered extracted joints will not be permitted.

#### 3.1.3.6 Plastic Pipe

PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

#### 3.1.3.7 NOT USED

#### 3.1.3.8 NOT USED

#### 3.1.3.9 NOT USED

#### 3.1.4 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper pipe shall be made with dielectric unions or flange waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

#### 3.1.5 NOT USED

#### 3.1.6 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

##### 3.1.6.1 Sleeve Requirements

Pipes passing through concrete or masonry walls or concrete floors shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves are not required for cast-iron soil pipe passing through concrete slab on grade. Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and concrete or masonry wall as specified in Section C-07920. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. A modular mechanical type sealing assembly may be installed in lieu of caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve with corrosion-protected carbon steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly



positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved.

Sleeves shall not be installed in structural members, except where indicated or approved. Sleeves through floors above grade shall be cut flush with each surface, except for sleeves passing through floors in wet areas such as mechanical equipment rooms, and other plumbing fixture areas, which shall extend a minimum of 4 inches above the finished floor.

Sleeves not intended to accept modular type seals shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe and inside of sleeve or between jacket over insulation and sleeves. Sleeves in bearing walls shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic. Plastic sleeves shall not be used in nonbearing fire walls, roofs, or floor/ceilings. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C 920 and with a primer, backstop material and surface preparation as specified in Section C-07920 JOINT SEALING.

3.1.6.2 NOT USED

3.1.6.3 NOT USED

3.1.6.4 NOT USED

3.1.6.5 NOT USED

3.1.7 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section C-07270 FIRESTOPPING.

3.1.8 Supports

3.1.8.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run.

3.1.8.2 Pipe Supports and Structural Bracing, Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads as specified Section C-13080 SEISMIC PROTECTION FOR MECHANICAL, ELECTRICAL EQUIPMENT. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, shall be provided. Material used for supports shall be as specified in Section C-05120 STRUCTURAL STEEL.

### 3.1.8.3 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

- a. Types 5, 12, and 26 shall not be used.
- b. Type 3 shall not be used on insulated pipe.
- c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.
- d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
- e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.
- h. Type 40 shields shall:
  - (1) be used on insulated pipe less than 4 inches.
  - (2) be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.
  - (3) have a high density insert for pipe 2 inches and larger and for smaller pipe sizes when the insulation is suspected of being visibly compressed, or distorted at or near the shield/insulation interface. High density inserts shall have a density of 8 pcf or greater.
- i. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.
- j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.
- k. Type 40 shields used on insulated pipe shall have high density inserts with a density of 8 pcf or greater.
- l. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:
  - (1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.
  - (2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
  - (3) On pipe 4 inches and larger carrying medium less than 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

m. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

n. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

o. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

### 3.1.9 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

### 3.1.10 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, and on each building drain outside the building. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws with frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Cleanout types shall be as indicated on the drawings.

## 3.2 WATER HEATERS

### 3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve

shall be provided on the cold water supply line to the water heater and mounted above and within 6 inches above the top of the tank or water heater.

### 3.2.2 Installation of Gas-Fired Water Heater

Installation shall conform to NFPA 54.

### 3.2.3 NOT USED

### 3.2.4 NOT USED

### 3.2.5 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

### 3.2.6 Expansion Tank

Install thermal expansion tank on hot water line leaving the water heater. Tank shall be A.S.M.E. rated with butyl rubber bladder suitable for 140°F service. Size shall be as indicated on the drawings.

## 3.3 FIXTURES AND FIXTURE TRIMMINGS

Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Plumbing fixtures and accessories shall be installed within the space shown.

### 3.3.1 NOT USED

### 3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket.

### 3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 42 inches above floor.

### 3.3.4 Shower Bath Outfits

The area around the water supply piping to the mixing valves and behind the escutcheon plate shall be made watertight by caulking or gasketing.

### 3.3.5 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a

foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

#### 3.3.5.1 NOT USED

#### 3.3.5.2 Support for Cellular-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the cellular wall using through bolts and a back-up plate.

#### 3.3.5.3 NOT USED

#### 3.3.5.4 NOT USED

#### 3.3.5.5 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

#### 3.3.6 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with NAPHCC-01 at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

#### 3.3.7 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section C-05500 MISCELLANEOUS METAL.

#### 3.3.8 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 2 inches (min.) above the flood rim of the funnel or as required to provide an acceptable air gap.

#### 3.3.9 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern,

or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D 3311.

#### 3.3.10 NOT USED

### 3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including compressors and pumps, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors. Isolation unit installation shall limit vibration to 40 percent of the lowest equipment rpm.

#### 3.4.1 Tank- or Skid-Mounted Compressors

Floor attachment shall be as recommended by compressor manufacturer.

#### 3.4.2 NOT USED

### 3.5 WATER METER REMOTE READOUT REGISTER

The remote readout register shall be mounted at the location indicated or as directed by the Contracting Officer.

### 3.6 IDENTIFICATION SYSTEMS

#### 3.6.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

#### 3.6.2 Color Coding

Color coding for piping identification shall be as specified in Section C-09900 PAINTING, GENERAL.

#### 3.6.3 NOT USED

### 3.7 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

### 3.8 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section C-09900 PAINTING, GENERAL.

### 3.9 TESTS, FLUSHING, AND STERILIZATION

#### 3.9.1 Plumbing System

The plumbing system shall be tested in accordance with NAPHCC-01.

##### 3.9.1.1 NOT USED

##### 3.9.1.2 Compressed Air Piping (Nonoil-Free)

Piping systems shall be filled with oil-free dry air or gaseous nitrogen to 150 psig and hold this pressure for 2 hours with no drop in pressure.

##### 3.9.2 NOT USED

##### 3.9.3 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be permitted.

##### 3.9.4 System Flushing

After tests are completed, potable water piping shall be flushed. In general, sufficient water shall be used to produce a minimum water velocity of 2.5 feet per second through piping being flushed. Flushing shall be continued until discharge water shows no discoloration. System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced in line. After flushing and cleaning, systems shall be prepared for service by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the work is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation.

##### 3.9.5 Operational Test

Upon completion of and prior to acceptance of the installation, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

- a. Time, date, and duration of test.
- b. Water pressures at the most remote and the highest fixtures.
- c. Operation of each fixture and fixture trim.
- d. Operation of each valve, hydrant, and faucet.
- e. NOT USED
- f. Temperature of each domestic hot-water supply.
- g. Operation of each floor drain by flooding with water.
- h. Operation of each vacuum breaker and backflow preventer.
- i. NOT USED

j. Compressed air readings at each compressor and at each outlet. Each indicating instrument shall be read at 1/2 hour intervals. The report of the test shall be submitted in quadruplicate. The Contractor shall furnish instruments, equipment, and personnel required for the tests; the Government will furnish the necessary water and electricity.

### 3.9.6 Sterilization

After pressure tests have been made, the entire domestic hot- and cold-water distribution system shall be sterilized. System shall be thoroughly flushed with water of sufficient velocity until all entrained dirt and other foreign material have been removed, before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a solution-feed chlorinator and booster pump, shall be used. The chlorine residual shall be checked at intervals to ensure that the proper level is maintained. Chlorine application shall continue until the entire main is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system being sterilized shall be opened and closed several times during the contact period to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. Water tanks shall be disinfected by the addition of chlorine directly to the filling water. Following a 6 hour period, no less than 50 ppm chlorine residual shall remain in the tank. The system including the tanks shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. From several points in the system the Contracting Officer will take samples of water in properly sterilized containers for bacterial examination. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA-01. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. The sterilizing shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

### 3.10 PLUMBING FIXTURE SCHEDULE

P-1 WATER CLOSET: Siphon-jet, elongated bowl, top supply spud, ASME A112.19.2M, wall mounted. Gasket shall be wax type. Seat - CID A-A-238, Type A, black plastic, elongated, open front. Flushometer Valve - ASSE 1037, large diaphragm type with non-hold-open feature, backcheck angle control stop, and vacuum breaker. Minimum upper chamber inside diameter of not less than 2-5/8 inches at the point where the diaphragm is sealed between the upper and lower chambers.

P-2 URINAL: Wall hanging, with integral trap and extended shields, ASME A112.19.2M siphon jet. Top supply connection, back outlet. Flushometer Valve - Similar to Flushometer Valve for P-1.

P-3 LAVATORY: Manufacturer's standard sink depth, ASME A112.19.1M, enameled cast iron, straight back. Faucet - Faucets shall be center set type. Faucets shall have metal replaceable cartridge control unit or metal cartridge units with diaphragm which can be replaced without special tools. Valves and handles shall be copper alloy. Connection between valve and spout for center-set faucet shall be of rigid metal tubing. Flow shall be limited to 2.5 gpm at a flowing



pressure. Handles - Crown type of cast, formed, or drop forged copper alloy. Drain - Strainer shall be copper alloy or stainless steel.

P-4 WASH FOUNTAIN: Semi-circular 54" (nom.) diameter, 14 gauge stainless steel bowl, with mixing valve, volume control, slow closing foot valve and foot operating mechanism.

P-5 SHOWER: Shower heads CID A-A-240, other than emergency showers, shall include a non-removable, tamperproof device to limit shower flow to 2.75 gpm when tested in accordance with ASME A112.18.1M. Wall Mounted: Shower head shall be stainless steel or chromium plated brass with ball joint. Valves shall be thermostatic mixing type, single lever operator, with stops and limit stop (set to 100 degree F). Internal serviceable components will be accessible through front by removal of handle or faceplate.

P-6A, B WATER COOLER DRINKING FOUNTAINS: Water cooler drinking fountains shall: be self contained, conform to ARI 1010, and use one of the halogenated fluorocarbons as a refrigerant. P-6A shall have a capacity to deliver 8 gph of water at 50 degrees F with an inlet water temperature of 80 degrees F while residing in a room environment of 90 degrees F, and have self-closing valves. P-6B shall have a capacity to deliver 11.5 gph of 50 degrees F water at same conditions as P-6A. Self-closing valves shall have automatic stream regulators, have a flow control capability, have a push button actuation or have a cross-shaped index metal turn handle without a hood. Exposed surfaces of stainless steel shall have No. 4 general polish finish. Spouts shall provide a flow of water at least 4 inches high so as to allow the insertion of a cup or glass under the flow of water. Units shall be simulated semi-recessed wall-mounted type and nominally 14 inches wide, 10 inches deep, and have a back height of 13 to 22 inches. The bowl shall be made of corrosion resisting steel and be for interior installation. The spout shall be at the front of the unit and direct the water flow in a trajectory that is parallel or nearly parallel to the front of the unit.

P-7 MOP BASIN: Molded terrazzo basin, nominal dimensions 24" x 24" x 10" high walls with not less than 1" thickness at rim and stainless steel drain body for connection to 3 inch diameter drain. Supply faucet shall be cast or wrought copper alloy, with top or bottom brace, and backflow preventer. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Handles shall be lever or four-arm type.

P-8 EMERGENCY DELUGE SHOWER/EYEWASH: Shower control shall be 1 inch or 1-1/2 inch stay-open type control valve. Unit shall be corrosion-resisting steel or enameled cast iron and shall be pedestal mounted.

P-9 WALL HYDRANT: Unit shall be in accordance with paragraph 2.3.3.

P-10 WALL FAUCET: Unit shall be in accordance with paragraph 2.3.2.

P-11 REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTER: Unit shall be in accordance with paragraph 2.5. Provide with manufacturer's recommended strainer.

P-12 THERMOSTATIC MIXING VALVE: System temperature control valve shall automatically control delivery water temperature regardless of supply pressure or temperature fluctuations down to a minimum flow rate of 2 gpm. Design maximum flow rate shall be as indicated in water heater schedule on the drawings. Unit body shall be of cast or wrought copper alloy with checkstop and union on inlets, wall support, cast lever handle, outlet control/shutoff valve and temperature gauge. Limit stop shall be set to 120 degrees F.

P-13A, C WATER HAMMER ARRESTOR: Pressurized and permanently sealed stainless steel compression chamber with nesting-type bellows separating pneumatic precharge and water system. Unit shall be in accordance with paragraph 3.1.1.7.

### 3.11 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

### 3.12 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, overall efficiency.

ET = Thermal efficiency with 70 degrees F delta T.

EC = Combustion efficiency, 100 percent - flue loss when smoke = 0 (trace is permitted).

SL = Standby loss in W/sq. ft. based on 80 degrees F delta T, or in percent per hour based on nominal 90 degrees F delta T.

HL = Heat loss of tank surface area.

V = Storage volume in gallons

#### 3.12.1 Storage Water Heaters

##### 3.12.1.1 NOT USED

##### 3.12.1.2 Gas

a. Storage capacity of 100 gallons or less, and input rating of 75,000 Btu/h or less: minimum EF shall be  $0.62 - 0.0019V$  per 10 CFR 430.

b. Storage capacity of more than 100 gallons - or input rating more than 75,000 Btu/h: ET shall be 77 percent; maximum SL shall be  $1.3 + 38/V$ , per ANSI Z21.10.3.

##### 3.12.1.3 NOT USED

#### 3.12.2 Unfired Hot Water Storage

Volumes and inputs: maximum HL shall be 6.5 Btu/h/sq. ft.

##### 3.12.3 NOT USED

##### 3.12.3.2 NOT USED

##### 3.12.4 NOT USED

TABLE I  
PIPE AND FITTING MATERIALS FOR  
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE			
Item No.	Pipe and Fitting Materials	A	B	C	D
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with compression gaskets	X	X	X	X
2	Cast iron pipe and fittings hubless, CISPI 301 and ASTM A 888		X		X
3	Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 6		X		
4	Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 6				X
5	Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 6				X
6	Steel pipe, seamless galvanized, ASTM A 53, Type S, Grade B		X		X
7	Bronzed flanged fittings, ASME B16.24 for use with Items 9				X
8	Cast copper alloy solder joint pressure fittings, ASME B16.18 for use with Item 9				X
9	Seamless copper pipe, ASTM B 42				X
10	Cast bronze threaded fittings, ASME B16.15				X
11	Copper drainage tube, (DWV), ASTM B 306	X*	X	X*	X
12	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X
13	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	X	X	X
14	Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D 2665, ASTM F 891, (Sch 40)	X	X		X

SERVICE:

- A - Underground Building Soil, Waste and Storm Drain
- B - Aboveground Soil, Waste, Drain In Buildings
- C - Underground Vent
- D - Aboveground Vent
- \* - Hard Temper

TABLE II  
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item No.	Pipe and Fitting Materials	SERVICE				
		A	B	C	D	Θ
1	Malleable-iron threaded fittings, Galvanized, ASME B16.3 for use with Item 3a	X	X			
	b. Same as "a" but not galvanized for use with Item 3b			X		
2	Grooved pipe couplings, ferrous pipe ASTM A 536 and ASTM A 47, non-ferrous pipe, ASTM A 536 and ASTM A 47	X	X			
3	Steel pipe: a. Seamless, galvanized, ASTM A 53, Type S, Grade B	X	X			
	b. Seamless, black, ASTM A 53, Type S, Grade B			X		
4	Bronze flanged fittings, ASME B16.24 for use with Items 3a and 3b	X	X			
5	Seamless copper pipe, ASTM B 42	X	X			
6	Seamless copper water tube, ASTM B 88	X**	X**	X*		X***
7	NOT USED					
8	Cast bronze threaded fittings, ASME B16.15 for use with Items 4 and 6	X	X			
9	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Items 6	X	X	X		
10	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Items 6	X	X	X		
11	NOT USED					

		SERVICE				
Item No.	Pipe and Fitting Materials	A	B	C	D	Θ
12	NOT USED					
13	NOT USED					
14	NOT USED					
15	NOT USED					
16	NOT USED					
17	NOT USED					
18	NOT USED					
19	NOT USED					
20	NOT USED					
22	NOT USED					
23	NOT USED					
24	NOT USED					
25	NOT USED					
26	NOT USED					
27	Steel pipeline flanges, MSS SP-44	X	X			
28	Fittings: brass or bronze, ASME B16.15, and ASME B16.18, ASTM B828	X	X			
29	Carbon steel pipe unions, socket-welding and threaded, MSS SP-83	X	X	X		
30	Malleable-iron threaded pipe unions ASME B16.39	X	X			
31	Nipples, pipe threaded ASTM A 733	X	X	X		

A - Cold Water Aboveground

B - Hot Water 80 degrees F Maximum Aboveground

C - Compressed Air Lubricated

D - Cold Water Service Belowground Indicated types are minimum wall thicknesses.

\* - Type M - Hard

\*\* - Type L - Hard

\*\*\* - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors

\*\*\*\* - In or under slab floors only brazed joints

Θ - Refer to Specifications Section 02660 for Cold Water Service below ground.

-- End of Section --



SECTION C-15488

GAS PIPING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN GAS ASSOCIATION (AGA)

AGA-01 (1989) A.G.A. Plastic Pipe Manual for Gas Service

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 6D (1994) Pipeline Valves  
(Gate, Plug, Ball, and Check Valves)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 539 (1990a) Electric-Resistance-Welded Coiled Steel Tubing for Gas and Fuel Oil Lines

ASTM B 88 (1995a) Seamless Copper Water Tube

ASTM B 210 (1995) Aluminum and Aluminum-Alloy Drawn Seamless Tubes

ASTM B 241 (1995a) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube

ASTM B 280 (1993a) Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1 (1983; R 1992) Pipe Threads, General Purpose (Inch)

ASME B16.3 (1992) Malleable Iron Threaded Fittings, Classes 150 and 300

ASME B16.5 (1988; Errata Oct 88; B16.5a) Pipe Flanges and Flanged Fittings

ASME B16.9 (1993) Factory-Made Wrought Steel Buttwelding Fittings

ASME B16.11 (1991) Forged Fittings, Socket-Welding and Threaded

ASME B16.21 (1992) Nonmetallic Flat Gaskets for Pipe Flanges

ASME B16.33	(1990) Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig (Sizes 1/2 through 2)
ASME B31.1	(1995) Power Piping
ASME B31.2	(1968) Fuel Gas Piping
ASME B36.10M	(1985; R 1994) Welded and Seamless Wrought Steel Pipe
ASME BPV IX	(1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS  
INDUSTRY (MSS)

MSS SP-25	(1993) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1991) Pipe Hangers and Supports - Selection and Application

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(1992) National Fuel Gas Code
NFPA 70	(1996) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL-06	(1994; Supple; Rev thru March 1996) Gas and Oil Equipment Directory
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## 1.2 GENERAL REQUIREMENTS

### 1.2.1 Welding

Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with Section IX of ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified at least 24 hours in advance of tests and the tests shall be performed at the work site if practicable. The Contracting Officer shall be furnished with a copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section C-05055 WELDING, STRUCTURAL.

### 1.2.2 NOT USED



### 1.2.3 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos shall not be used. Manufacturer's descriptive data and installation instructions shall be submitted for approval for compression-type mechanical joints used in joining dissimilar materials and for insulating joints. Valves, flanges and fittings shall be marked in accordance with MSS SP-25.

### 1.2.4 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

#### SD-01 Data

Qualifications; FIO.

Qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

#### SD-04 Drawings

Gas Piping System; GA.

Drawings showing location, size and all branches of pipeline; location of all required shutoff valves; and instructions necessary for the installation of connectors and supports.

## PART 2 PRODUCTS

### 2.1 PIPE AND FITTINGS

#### 2.1.1 Steel Pipe, Joints, and Fittings

Steel pipe shall conform to ASME B36.10M. Malleable-iron threaded fittings shall conform to ASME B16.3. Steel pipe flanges and flanged fittings including bolts, nuts, and bolt pattern shall be in accordance with ASME B16.5. Wrought steel butt welding fittings shall conform to ASME B16.9. Socket welding and threaded forged steel fittings shall conform to ASME B16.11.

#### 2.1.2 Aluminum Alloy Pipe and Tubing, Joints, and Fittings

Aluminum alloy pipe shall conform to ASTM B 241, except alloy 5456 shall not be used, and the ends of each length of pipe shall be marked indicating it conforms to NFPA 54. Pipe joints shall be threaded, flanged, brazed or welded.

Aluminum alloy tubing shall conform to ASTM B 210, Type A or B, or ASTM B 241, Type A or equivalent. Tubing joints shall be made up with gas tubing fittings recommended by the tubing manufacturer.

### 2.1.3 Copper Tubing, Joints and Fittings

Copper tubing shall conform to ASTM B 88, Type K or L, or ASTM B 280. Tubing joints shall be made up with tubing fittings recommended by the tubing manufacturer.

### 2.1.4 Steel Tubing, Joints and Fittings

Steel tubing shall conform to ASTM A 539. Tubing joints shall be made up with gas tubing fittings recommended by the tubing manufacturer.

### 2.1.5 NOT USED

### 2.1.6 NOT USED

### 2.1.7 Sealants for Steel Pipe Threaded Joints

Joint sealing compound shall be listed in UL-06, Class 20 or less. Tetrafluoroethylene tape shall conform to UL-06.

### 2.1.8 Identification

Pipe flow markings and metal tags shall be provided as required.

### 2.1.9 Flange Gaskets

Gaskets shall be nonasbestos compressed material in accordance with ASME B16.21, 1/16-inch thickness, full face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR) suitable for a maximum 600 degree F service. NBR binder shall be used for hydrocarbon service.

### 2.1.10 Pipe Threads

Pipe threads shall conform to ASME B1.20.1.

### 2.1.11 Escutcheons

Escutcheons shall be chromium-plated steel or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screw.

### 2.1.12 NOT USED

### 2.1.13 Insulating Pipe Joints

#### 2.1.13.1 Insulating Joint Material

Insulating joint material shall be provided between flanged or threaded metallic pipe systems where shown to control galvanic or electrical action.

#### 2.1.13.2 Threaded Pipe Joints

Joints for threaded pipe shall be steel body nut type dielectric unions with insulating gaskets.

#### 2.1.13.3 Flanged Pipe Joints

Joints for flanged pipe shall consist of full face sandwich-type flange insulating gasket of the dielectric type, insulating sleeves for flange bolts, and insulating washers for flange nuts.

#### 2.1.14 NOT USED

### 2.2 VALVES

Valves shall be suitable for shutoff or isolation service and shall conform to the following:

#### 2.2.1 Valves 2 Inches and Smaller

Valves 2 inches and smaller shall conform to ASME B16.33 and shall be of materials and manufacture compatible with system materials used.

#### 2.2.2 Valves 2-1/2 Inches and Larger

Valves 2-1/2 inches and larger shall be carbon steel conforming to API Spec 6D, Class 150.

### 2.3 PIPE HANGERS AND SUPPORTS

Pipe hangers and supports shall conform to MSS SP-58 and MSS SP-69.

### 2.4 METERS, REGULATORS AND SHUTOFF VALVES

Meters, regulators and shutoff valves shall be as specified in Section C-02685 GAS DISTRIBUTION SYSTEM.

## PART 3 EXECUTION

### 3.1 NOT USED

### 3.2 GAS PIPING SYSTEM

Gas piping system shall be from the point of delivery, defined as the outlet of the meter set, service regulator and shutoff valve assembly, specified in Section C-02685 GAS DISTRIBUTION SYSTEM, to the connections to each gas utilization device.

#### 3.2.1 Protection of Materials and Components

Pipe and tube openings shall be closed with caps or plugs during installation. Equipment shall be protected from dirt, water, and chemical or mechanical damage. At the completion of all work, the entire system shall be thoroughly cleaned.

#### 3.2.2 Workmanship and Defects

Piping, tubing and fittings shall be clear and free of cutting burrs and defects in structure or threading and shall be thoroughly brushed and chip-and scale-blown. Defects in piping, tubing or fittings shall not be repaired. When defective piping, tubing, or fittings are located in a system, the defective material shall be replaced.

### 3.3 PROTECTIVE COVERING

#### 3.3.1 NOT USED

### 3.3.2 Aboveground Exterior Metallic Piping Systems

#### 3.3.2.1 Ferrous Surfaces

Shop primed surfaces shall be touched up with ferrous metal primer. Surfaces that have not been shop primed shall be solvent cleaned. Surfaces that contain loose rust, loose mill scale and other foreign substances shall be mechanically cleaned by power wire brushing and primed with ferrous metal primer. Primed surface shall be finished with two coats of exterior oil paint or vinyl paint.

#### 3.3.2.2 Nonferrous Surfaces

Except for aluminum alloy pipe, nonferrous surfaces shall not be painted. Surfaces of aluminum alloy pipe and fittings shall be painted to protect against external corrosion where they contact masonry, plaster, insulation, or are subject to repeated wettings by such liquids as water, detergents or sewage. The surfaces shall be solvent-cleaned and treated with vinyl type wash coat. A first coat of aluminum paint and a second coat of alkyd gloss enamel or silicone alkyd copolymer enamel shall be applied.

### 3.4 INSTALLATION

Installation of the gas system shall be in conformance with the manufacturer's recommendations and applicable provisions of NFPA 54, AGA-01, and as indicated. Pipe cutting shall be done without damage to the pipe. Unless otherwise authorized, cutting shall be done by an approved type of mechanical cutter. Wheel cutters shall be used where practicable. On steel pipe 6 inches and larger, an approved gas cutting and beveling machine may be used. Cutting of thermoplastic and fiberglass pipe shall be in accordance with AGA-01.

#### 3.4.1 Metallic Piping Installation

Changes in direction of piping shall be made with fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Aluminum alloy pipe shall not be used in exterior locations or underground.

#### 3.4.2 Metallic Tubing Installation

Metallic tubing shall be installed using gas tubing fittings approved by the tubing manufacturer. Branch connections shall be made with tees. All tubing end preparation shall be made with tools designed for the purpose. Aluminum alloy tubing shall not be used in exterior locations or underground.

#### 3.4.3 NOT USED

#### 3.4.4 NOT USED

#### 3.4.5 NOT USED

#### 3.4.6 Concealed Piping in Buildings

When installing piping which is to be concealed, unions, tubing fittings, running threads, right- and left-hand couplings, bushings, and swing joints made by combinations of fittings shall not be used.

##### 3.4.6.1 Piping in Partitions

Concealed piping shall be located in hollow rather than solid partitions. Tubing passing through walls or partitions shall be protected against physical damage.

#### 3.4.6.2 NOT USED

#### 3.4.7 Aboveground Piping

Aboveground piping shall be run as straight as practicable along the alignment indicated and with a minimum of joints. Piping shall be separately supported.

#### 3.4.8 Final Gas Connections

Unless otherwise specified herein, final connections shall be made with rigid metallic pipe and fittings. Provide accessible gas shutoff valve and coupling for each gas equipment item.

### 3.5 PIPE JOINTS

Pipe joints shall be designed and installed to effectively sustain the longitudinal pull-out forces caused by contraction of the piping or superimposed loads.

#### 3.5.1 Threaded Metallic Joints

Threaded joints in metallic pipe shall have tapered threads evenly cut and shall be made with UL approved graphite joint sealing compound for gas service or tetrafluoroethylene tape applied to the male threads only. Threaded joints up to 1-1/2 inches in diameter may be made with approved tetrafluoroethylene tape. Threaded joints up to 2 inches in diameter may be made with approved joint sealing compound. After cutting and before threading, pipe shall be reamed and burrs shall be removed. Caulking of threaded joints to stop or prevent leaks shall not be permitted.

#### 3.5.2 Welded Metallic Joints

Beveling, alignment, heat treatment, and inspection of welds shall conform to ASME B31.2. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected adversely. Electrodes that have been wetted or have lost any of their coating shall not be used.

#### 3.5.3 NOT USED

#### 3.5.4 Flared Metallic Tubing Joints

Flared joints in metallic tubing shall be made with special tools recommended by the tubing manufacturer. Flared joints shall be used only in systems constructed from nonferrous pipe and tubing, when experience or tests have demonstrated that the joint is suitable for the conditions, and when adequate provisions are made in the design to prevent separation of the joints. Metallic ball sleeve compression-type tubing fittings shall not be used for tubing joints.

#### 3.5.5 Solder or Brazed Joints

Joints in metallic tubing and fittings shall be made with materials and procedures recommended by the tubing supplier. Joints shall be brazed with material having a melting point above 1000 degrees F. Brazing alloys shall not contain phosphorous.

### 3.5.6 NOT USED

### 3.6 PIPE SLEEVES

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall not be installed in structural members except where indicated or approved. Each sleeve shall extend through its respective wall, floor or roof, and shall be cut flush with each surface, except in mechanical room floors not located on grade where clamping flanges or riser pipe clamps are used. Sleeves in mechanical room floors above grade shall extend at least 4 inches above finish floor. Unless otherwise indicated, sleeves shall be large enough to provide a minimum clearance of 1/4 inch all around the pipe. Sleeves in bearing walls, waterproofing membrane floors, and wet areas shall be steel pipe. Sleeves in nonbearing walls, floors, or ceilings may be steel pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic. Except in pipe chases, interior walls, or fire-rated partitions, the annular space between pipe and sleeve shall be sealed with backstop material and sealant as specified in Section C-07920 CALKING AND SEALANTS.

### 3.7 NOT USED

### 3.8 FIRE SEAL

Penetrations of fire rated partitions, walls and floors shall be in accordance with Section C-07270 FIRESTOPPING.

### 3.9 ESCUTCHEONS

Escutcheons shall be provided for all finished surfaces where gas piping passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms.

### 3.10 SPECIAL REQUIREMENTS

Drips, grading of the lines, freeze protection, and branch outlet locations shall be as shown and shall conform to the requirements of NFPA 54.

### 3.11 BUILDING STRUCTURE

Building structure shall not be weakened by the installation of any gas piping. Beams or joists shall not be cut or notched.

### 3.12 PIPING SYSTEM SUPPORTS

Gas piping systems in buildings shall be supported with pipe hooks, metal pipe straps, bands or hangers suitable for the size of piping or tubing. Gas piping system shall not be supported by other piping. Spacing of supports in gas piping and tubing installations shall conform to the requirements of NFPA 54. The selection and application of supports in gas piping and tubing installations shall conform to the requirements of MSS SP-69. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for any of the individual pipes in the multiple pipe run. The clips or clamps shall be rigidly connected to the common base member. A clearance of 1/8 inch shall be provided between the pipe and clip or clamp for all piping which may be subjected to thermal expansion.

### 3.13 ELECTRICAL BONDING AND GROUNDING

A gas piping system within a building shall be electrically continuous and bonded to a grounding electrode as required by NFPA 70.

#### 3.14 SHUTOFF VALVE

Main gas shutoff valve controlling the gas piping system shall be easily accessible for operation and shall be installed as indicated, protected from physical damage, and marked with a metal tag to clearly identify the piping system controlled.

#### 3.15 NOT USED

#### 3.16 TESTING

Before any section of a gas piping system is put into service, it shall be carefully tested to assure that it is gastight. Prior to testing, the system shall be blown out, cleaned and cleared of all foreign material. Each joint shall be tested by means of an approved gas detector, soap and water, or an equivalent nonflammable solution. Testing shall be completed before any work is covered, enclosed, or concealed. All testing of piping systems shall be done with due regard for the safety of employees and the public during the test. Bulkheads, anchorage and bracing suitably designed to resist test pressures shall be installed if necessary. Oxygen shall not be used as a testing medium.

##### 3.16.1 Pressure Tests

Before appliances are connected, piping systems shall be filled with air or an inert gas and shall withstand a minimum pressure of 3 pounds gauge for a period of not less than 10 minutes as specified in NFPA 54 without showing any drop in pressure. Oxygen shall not be used. Pressure shall be measured with a mercury manometer, slope gauge, or an equivalent device so calibrated as to be read in increments of not greater than 0.1 pound. The source of pressure shall be isolated before the pressure tests are made.

##### 3.16.2 NOT USED

##### 3.16.3 Test With Gas

Before turning gas under pressure into any piping, all openings from which gas can escape shall be closed. Immediately after turning on the gas, the piping system shall be checked for leakage by using a laboratory-certified gas meter, an appliance orifice, a manometer, or equivalent device. All testing shall conform to the requirements of NFPA 54. If leakage is recorded, the gas supply shall be shut off, the leak shall be repaired, and the tests repeated until all leaks have been stopped.

##### 3.16.4 Purging

After testing is completed, and before connecting any appliances, all gas piping shall be fully purged. LPG piping tested using fuel gas with appliances connected does not require purging. Piping shall not be purged into the combustion chamber of an appliance. The open end of piping systems being purged shall not discharge into confined spaces or areas where there are ignition sources unless the safety precautions recommended in NFPA 54 are followed.

##### 3.16.5 Labor, Materials and Equipment

All labor, materials and equipment necessary for conducting the testing and purging shall be furnished by the Contractor.

-- End of Section --



SECTION C-15565

HEATING SYSTEM; GAS-FIRED HEATERS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN GAS ASSOCIATION LABORATORIES (AGAL)

AGAL-01 (1995; Supple Dec 95) Directory of Certified Appliances and Accessories

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.66 (1988; Z21.66a; Z21.66b) Automatic Vent Damper Devices for Use with Gas-Fired Appliances

ANSI Z83.4 (1991; Z83.4a) Direct Gas-Fired Make-Up Air Heaters

ANSI Z83.6 (1990 Z83.6a; Z83.6b) Gas-Fired Infrared Heaters

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (1993; Rev 1) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54 (1992) National Fuel Gas Code

NFPA 211 (1992) Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances

UNDERWRITERS LABORATORIES (UL)

UL-06 (1995) Gas and Oil Equipment Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-01 Data

Heating System; FIO.

Spare parts data for each different item of materials and equipment specified, after approval of the detail drawings, and not later than 3 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

## SD-04 Drawings

Heating System; GA.

Detail drawings consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operation of the system. Detail drawings for space heating equipment, controls, associated equipment, and for piping and wiring. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

## SD-06 Instructions

Heating System; FIO.

Six complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and basic operating features. Six complete copies of maintenance instructions listing routine maintenance, possible breakdowns, repairs and troubleshooting guide. The instructions shall include simplified piping, wiring, and control diagrams for the system as installed.

## SD-09 Reports

Testing, Adjusting, and Balancing; FIO.

Test reports shall be submitted in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

### 1.3 GENERAL REQUIREMENTS

#### 1.3.1 Nameplates

Each major component of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the equipment.

#### 1.3.2 Equipment Guards

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts so located that any person may come in close proximity thereto shall be completely enclosed or guarded. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be guarded or covered with insulation of type specified for service.

#### 1.3.3 Verification of Dimensions

The Contractor shall become thoroughly familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

### 1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from weather, humidity and temperature variations, dirt and dust, or other contaminants.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

Material and equipment shall be standard products of a manufacturer regularly engaged in manufacturing of the products. Equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

### 2.2 ELECTRICAL WORK

Electrical motor driven equipment shall be provided complete with motors and controls. Motors shall conform to NEMA MG 1. Electrical equipment and wiring shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Electrical characteristics shall be as specified or indicated. Unless otherwise indicated motors of 1 Hp and above shall be high efficiency type. Each motor shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

### 2.3 HEATERS

Heaters shall be equipped for and adjusted to burn natural gas. Each heater shall be provided with a gas pressure regulator that will satisfactorily limit the main gas burner supply pressure. Heaters shall have an intermittent or interrupted electrically ignited pilot or a direct electric ignition system. Safety controls shall conform to the ANSI standard specified for each heater. Mounting brackets and hardware shall be furnished by the heater manufacturer and shall be factory finished to match the supported equipment.

#### 2.3.1 Direct Fired Make-Up Air Heaters

##### 2.3.1.1 Heaters

Heaters shall be direct fired type drawing 100 percent outside air, and shall conform to requirements of ANSI Z83.4. Heaters shall be equipped with motorized inlet dampers, duct collar, air filters and all controls and safety features indicated or required for proper operation. Gas control valve shall be modulating type. Maximum air temperature rise during minimum burner fire shall be 7 degrees F. Motorized inlet dampers shall be closed when the unit is shut down. Dampers shall be interlocked to prevent burner operation when dampers are closed.

##### 2.3.1.2 MAU Unit Controls

Units shall be provided with a remote mounted monitoring and control panel located as shown. Panel shall be suitable for flush mounting. The remote panel shall have the following features:

- a. System "On-Off" selector switch
- b. Discharge temperature set point selector knob
- c. Safety lockout reset switch
- d. Indicator lights for

1. Burner On
  2. Blower On
  3. Low Temperature (provide terminal for EMCS)
  4. Dirty Filter (provide terminal for EMCS)
- e. Removable cover with engraved letters identifying each feature
  - f. Terminal block for wiring

Discharge air thermostats shall be modulating type with 3-degree F differential. The discharge air thermostat shall be adjustable with a setpoint of 0 to 100 degrees F. The discharge air thermostat shall control the modulating gas control valve. A low limit air stream thermostat shall shut down the entire unit if the discharge air temperature drops below the discharge thermostat setting. An ambient thermostat shall lockout the burner if the outside air exceeds the discharge thermostat setting. A differential pressure switch shall monitor pressure drop across the air filter.

#### 2.3.2 NOT USED

#### 2.3.3 NOT USED

#### 2.3.4 Infrared Heaters

##### 2.3.4.1 Heaters

Heaters shall conform to the requirements of ANSI Z83.6 and shall be vented type. Vented heaters shall be vented to the outside atmosphere. Heater style shall be tubular type. Reflector shape shall be parabolic horizontal or standard as indicated.

##### 2.3.4.2 Space Thermostats

Thermostats shall be the adjustable electric or electronic type. Control wiring to complete the space temperature control system shall be included. Space thermostats shall have 3-degree F differential and set point range of 40 to 75 degrees F. Thermostats shall control the burner. Thermostats located in the direct radiation pattern shall be covered with a metal shield.

#### 2.4 VENT PIPING

Vent piping shall conform to the requirements of NFPA 54.

#### 2.5 ELECTRIC AUTOMATIC VENT DAMPERS

Electric automatic vent dampers shall conform to the requirements of ANSI Z21.66 and shall be provided in the vents of heaters using indoor air for combustion air.

#### 2.6 INSULATION

Insulation for piping and equipment and application shall be in accordance with Section C-15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

#### 2.7 FACTORY FINISHES

Equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish.

### PART 3 EXECUTION

### 3.1 INSTALLATION

Equipment shall be installed as indicated and in accordance with the recommendations of the equipment manufacturer and the listing agency, except as otherwise specified.

#### 3.1.1 Heating Equipment

Heaters shall be installed with clearance to combustibles complying with minimum distances as determined by AGAL-01, UL-06 and as indicated on each heater approval and listing plate. Heaters shall be independently supported from the building structure as indicated and shall not rely on support from suspended ceiling systems.

#### 3.1.2 Vents

Vent dampers, piping and structural penetrations shall be located as indicated. Vent damper installation shall conform to ANSI Z21.66. Vent pipes, where not connected to a masonry chimney conforming to NFPA 211, shall extend through the roof or an outside wall and shall terminate, in compliance with NFPA 54. Vents passing through waterproof membranes shall be provided with the necessary flashings to obtain waterproof installations.

#### 3.1.3 Gas Piping

Gas piping shall be connected as indicated and shall comply with the applicable requirements at Section C-15488 GAS PIPING SYSTEMS.

### 3.2 TESTING, ADJUSTING, AND BALANCING

Testing, adjusting, and balancing shall be as specified in Section 15990 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

### 3.3 Training

The Contractor shall conduct a training course for the maintenance and operating staff. The training period of 8 hours normal working time shall start after the system is functionally complete but before the final acceptance tests. The training shall include all of the items contained in the operating and maintenance instructions as well as demonstrations of routine maintenance operations. The Contracting Officer shall be given at least two weeks advance notice of such training.

-- End of Section --

SECTION C-15569

WATER HEATING; GAS; UP TO 20 MBTUH

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.13 (1991; Z21.13a; Z21.13b) Gas-Fired Low-Pressure Steam and Hot Water Boilers

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47 (1990) Ferritic Malleable Iron Castings

ASTM A 53 (1995a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

ASTM A 105 (1997) Forgings, Carbon Steel, for Piping Components

ASTM A 106 (1994) Seamless Carbon Steel Pipe for High-Temperature Service

ASTM A 167 (1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

ASTM A 183 (1983, R 1990) Carbon Steel Track Bolts and Nuts

ASTM A 193 (1996) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

ASTM A 234 (1996) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

ASTM A 366 (1991; R 1993) Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality

ASTM A 515 (1992) Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service

ASTM A 516 (1990) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service

ASTM A 536 (1984; R 1993) Ductile Iron Castings

ASTM A 653 (1995) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM B 32 (1995a) Solder Metal

ASTM B 62 (1993) Composition Bronze or Ounce Metal Castings

ASTM B 75 (1993) Seamless Copper Tube

ASTM B 88	(1996) Seamless Copper Water Tube
ASTM B 813	(1993) Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
ASTM B 828	(1992) Making Capillary Joints by Soldering of Copper and Copper-Alloy Tube and Fittings
ASTM C 27	(1993) Fireclay and High-Alumina Refractory Brick
ASTM C 34	(1993) Structural Clay Load-Bearing Wall Tile
ASTM C 155	(1988; R 1992) Classification of Insulating Firebrick
ASTM C 401	(1991) Alumina and Alumina Silicate Castable Refractories
ASTM D 596	(1991) Reporting Results of Analysis of Water
ASTM D 1784	(1992) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2000	(1990; R 1994) Rubber Products in Automotive Applications
ASTM F 872	(1984; R 1990) Filter Units, Air Conditioning: Viscous-Impingement Type, Cleanable
ASTM F 1097	(1991) Mortar, Refractory (High-Temperature, Air-Setting)
ASTM F 1139	(1988; R 1993) Standard Specification for Steam Traps and Drains

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.4	(1992) Gray Iron Threaded Fittings
ASME B16.5	(1988; Errata Oct 88; B16.5a) Pipe Flanges and Flanged Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1991) Forged Fittings, Socket-Welding and Threaded
ASME B16.15	(1985; R 1994) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1989) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.34	(1988) Valves - Flanged, Threaded and Welding End
ASME B16.39	(1986; R 1994) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B19.3	(1991; B19.3a; B19.3b) Safety Standard for Compressors for Process Industries
ASME B31.1	(1995) Power Piping
ASME B31.5	(1992; B31.5a) Refrigeration Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPV IV	(1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section IV, Heating Boilers
ASME BPV VIII Div 1	(1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME BPV IX	(1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME CSD-1	(1992; CSD-1a; CSD-1b) Controls and Safety Devices for Automatically Fired Boilers
ASME PTC 10	(1965; Errata; R 1992) Compressors and Exhausters

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606	(1987) Grooved and Shouldered Joints
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AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
AWS B2.2	(1991) Brazing Procedure and Performance Qualification

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1419	(Rev D) Filter Element, Air Conditioning (Viscous- Impingement and Dry Types, Replaceable)
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COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA 404/0 RR	(1993) Copper Tube for Plumbing, Heating, Air Conditioning and Refrigeration
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EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA)

EJMA-01	(1993) EJMA Standards
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HYDRONICS INSTITUTE (HYI)

HYI-01	(1996) I=B=R Ratings for Boilers, Baseboard Radiation
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and Finned Tube (Commercial) Radiation

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND  
FITTINGS INDUSTRY (MSS)

MSS SP-25	(1993) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1990) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1990) Cast Iron Swing Check Valves, Flanges and Threaded Ends
MSS SP-72	(1992) Ball Valves with Flanged or Butt-welding Ends for General Service
MSS SP-73	(1991) Brazing Joints for Copper and Copper Alloy Pressure Fittings
MSS SP-78	(1987; R 1992) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
MSS SP-110	(1992) Ball Valves Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	(1992) Installation of Oil Burning Equipment
NFPA 54	(1992) National Fuel Gas Code
NFPA 70	(1996) National Electrical Code
NFPA 85C	(1991) Prevention of Furnace Explosions/Implosions in Multiple Burner Boiler-Furnaces
NFPA 211	(1992) Chimneys, Fireplaces, Vents and Solid Fuel-Burning Appliances
NFPA 8501	(1992) Single Burner Boiler Operations

UNDERWRITERS LABORATORIES (UL)

UL-06	(1996) Gas and Oil Equipment Directory
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UL 296	(1994; Rev Aug 1995) Oil Burners
UL 726	(1995) Oil-Fired Boiler Assemblies
UL 795	(1994; Rev Jan 1996) Commercial-Industrial Gas Heating Equipment
UL 1738	(1993) Venting Systems for Gas-Burning Appliances, Categories II, III and IV

## 1.2 GENERAL REQUIREMENTS

### 1.2.1 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

### 1.2.2 Asbestos Prohibition

Asbestos and asbestos-containing products shall not be used.

### 1.2.3 Nameplates

Each major component of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the equipment. Each pressure vessel shall have an approved ASME stamp.

### 1.2.4 Equipment Guards

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded in accordance with OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

### 1.2.5 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work or ordering any materials.

### 1.2.6 Welding

Boilers and piping shall be welded and brazed in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practical. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section C-05055 WELDING, STRUCTURAL.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

#### SD-01 Data

Manufacturer's Catalog Data; GA.

Manufacturer's catalog data shall be included with the detail drawings for the following items:

- Boilers
- Fuel Burning Equipment
- Combustion Control Equipment
- Pumps
- Fittings and Accessories
- Fuel Oil Storage System
- Water Treatment System

The data shall show model, size, options, etc., that are intended for consideration. Data submitted shall be adequate to demonstrate compliance with all contract requirements.

Spare Parts Data; FIO.

Spare parts data for each different item of material and equipment, after approval of the detail drawings and no later than two months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 and 3 years of service.

Heating and Fuel Systems Test Procedures; FIO.

Proposed test procedures for the heating system tests and fuel system tests, at least 2 weeks prior to the start of related testing.

Welding Procedures; FIO.

A copy of qualified welding procedures, at least 2 weeks prior to the start of welding operations.

Qualification; FIO.

A statement from the firms proposed to prepare submittals and perform installation and testing, demonstrating successful completion of similar services or at least 5 projects of similar size or scope, at least 2 weeks prior to the submittal of any other item required by this section.

Welding Qualification; FIO.

A list of names and identification symbols of qualified welders and welding operators, at least 2 weeks prior to the start of welding operations.

#### SD-04 Drawings

Heating System; GA.

Detail drawings consisting of equipment layout including installation details and electrical connection diagrams; combustion and safety control diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static

pressure and seal classifications and piping layout showing the location of all guides and anchors, the load imposed on each support or anchor, and typical support details. Drawings shall include any information required to demonstrate that the system has been coordinated and will properly function as a unit and shall show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

#### SD-06 Instructions

Posted Instructions; GA.

System layout diagrams that show the layout of equipment, piping, and ductwork and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system, framed under glass or laminated plastic, at least 2 weeks prior to the start of related testing. After approval, these items shall be posted where directed.

#### SD-07 Schedules

Tests; GA.

Proposed test schedules for the heating system and fuel system tests, at least 2 weeks prior to the start of related testing.

#### SD-09 Reports

Heating System and Fuel System Tests; FIO.

Test reports for the heating system tests and the fuel system test, upon completion of testing complete with results.

#### SD-13 Certificates

Bolts; FIO.

Written certification by the bolt manufacturer that the bolts furnished comply with the requirements of this specification. The certification shall include illustrations of product markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification.

Boiler Emissions; FIO.

Written certification by the boiler manufacturer that each boiler furnished complies with Federal, state, and local regulations for emissions. The certification shall also include a description of applicable emission regulations. If any boiler is exempt from the emission regulations, the certification shall indicate the reason for the exemption.

#### SD-19 Operation and Maintenance Manuals

Heating System; FIO.

Six complete manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 2 weeks prior to field training. The manuals shall include the manufacturer's name, model number, parts list, simplified wiring and control diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

#### 1.4 MANUFACTURER'S SERVICES

Services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The representative shall supervise the installing, adjusting, and testing of the equipment.

#### 1.5 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be protected from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

### PART 2 PRODUCTS

#### 2.1 BOILERS

Each boiler shall have the output capacity in British thermal units per hour (Btuh) as indicated when fired with the specified fuels. The boiler shall be furnished complete with the gas burning equipment, boiler fittings and trim, automatic controls, natural draft/atmospheric burner, electrical wiring, insulation, piping connections, and protective jacket. The boiler shall be completely assembled and tested at the manufacturer's plant. Boiler auxiliaries including motors, drives, and similar equipment shall be provided with at least 10 percent excess capacity to allow for field variations in settings and to compensate for any unforeseen increases in pressure losses in appurtenant piping and ductwork. However, the boiler safety devices shall not be sized for a 10 percent excess capacity. The boiler and its accessories shall be designed and installed to permit ready accessibility for operation, maintenance, and service. Boilers shall be designed, constructed, and equipped in accordance with ASME BPV IV. Each boiler shall be of the cast iron type and designed for water service as specified herein. The boiler capacity shall be based on the ratings shown in the HYI-01 or as certified by the American Boiler Manufacturers Association, or American Gas Association.

##### 2.1.1 NOT USED

##### 2.1.2 NOT USED

##### 2.1.3 Cast Iron Boiler

Boiler shall be of the rectangular, sectional type, self-contained, packaged type, complete with all accessories, mounted on a structural steel base.

##### 2.1.4 Hot Water Heating Boilers

The hot water heating boiler shall be capable of operating at the specified maximum continuous capacity without damage or deterioration to the boiler, its setting, firing equipment, or auxiliaries. The rated capacity shall be the capacity at which the boiler will operate continuously while maintaining at least the specified minimum efficiency. The boiler design conditions shall be as follows:

- a. Boiler design pressure 30 psig.
- b. Operating pressure at boiler outlet 17 psig.
- c. Hot water temperature 200 degrees F.
- d. Temperature differential between boiler discharge and system return 20 degrees F.
- e. Outdoor ambient air temperature 65 degrees F (max), 10 degrees F (min).
- f. Site elevation 535 feet.
- g. Maximum continuous output 160,000 Btuh.
- h. Rated input 250,000 Btuh.

- i. Maximum exhaust stack temperature 600 degrees F.

#### 2.1.5 NOT USED

### 2.2 FUEL BURNING EQUIPMENT

Boiler shall be designed to burn gas.

#### 2.2.1 Burners

##### 2.2.1.1 Gas Fired Burners and Controls

Burners shall be UL approved natural draft/atmospheric burners. Burner shall be provided complete with fuel supply system in conformance with the following safety codes or standards:

- a. Gas-fired units shall conform to UL 795. Gas fired units less than 12,500,000 Btuh input shall conform to ANSI Z21.13.

##### 2.2.1.2 NOT USED

##### 2.2.1.3 NOT USED

#### 2.2.2 NOT USED

#### 2.2.3 Draft Damper

Boilers shall be provided with automatic damper, and draft hood as recommended by the boiler manufacturer to maintain proper draft in the boiler. Draft damper shall be provided in a convenient and accessible location in the flue gas outlet from the boiler.

##### 2.2.4 NOT USED

### 2.3 COMBUSTION CONTROL EQUIPMENT

Combustion control equipment shall be provided as a system by a single manufacturer. Field installed automatic combustion control system shall be installed in accordance with the manufacturer's recommendations and under the direct supervision of a representative of the control manufacturer. The boiler water shall be controlled by a water temperature controller. The controller shall start or stop the burner as the water temperature falls below or rises above preset points. Burner flame safety and combustion controls shall be UL listed, microprocessor-based distributed process controller. The controller shall be composed of an EPROM type chip. The system shall include all mounting hardware, wiring and cables, and associated equipment. The controller shall be mounted completely wired, programmed, debugged, and tested to perform all of its functions. The controller shall process the signals for complete control and monitoring of the boiler. This shall include maintaining boiler status, starting and stopping all control functions, sequencing control functions and signaling alarm conditions. The program shall be documented and include cross references in description of coils and contacts. Microprocessor shall be able to perform self diagnostics, possess a nonvolatile memory, and contain a message center to provide operator with status and failure mode information. Controllers for each boiler shall be mounted on a separate, free standing panel adjacent to the boiler or for packaged boilers on the boiler supporting structure. The equipment shall operate electrically. Each boiler controller shall be provided with a means for manually controlling the firing rate when required by the boiler sequence of operation. If recording instruments are provided, a 1-year supply of ink and 400 blank charts for each recorder shall be furnished.

#### 2.3.1 NOT USED

#### 2.3.2 Electrical Controls

Electrical control devices shall be rated at 120 volts and shall be connected as specified in Section C-16415 ELECTRICAL WORK, INTERIOR.

#### 2.3.3 Water Temperature Controller

The controller regulating the boiler-water temperature shall be of sturdy construction and shall be protected against dust and dampness. The thermostatic element shall be inserted in a separable socket installed in the upper part of the boiler near the water outlet. The controller shall operate on a 10 degree F differential over an adjustable temperature range of approximately 140 to 220 degrees F.

#### 2.3.4 NOT USED

#### 2.3.5 NOT USED

#### 2.3.6 Combustion Safety Controls and Equipment

Control systems and safety devices for automatically fired boilers shall conform to ASME CSD-1. Electrical combustion and safety controls shall be rated at 120 volts, single phase, 60 Hz and shall be connected as specified in Section C-16415 ELECTRICAL WORK, INTERIOR. A minimum 4-inch diameter alarm bell shall be provided and shall be located where indicated or directed. The alarm bell shall ring when the boiler is shut down by any safety control or interlock. Indicating lights shall be provided on the control panel. A red light shall indicate flame failure, and a green light shall indicate that the main fuel valve is open. In the event of power failure, the boiler shall automatically restart when power is restored. The following shutdown conditions shall require a manual reset before the boiler can automatically recycle:

- a. Flame failure.
- b. Failure to establish pilot flame.
- c. Failure to establish main flame.
- d. Supplementary low-water cutoff.
- e. High temperature cutoff.

##### 2.3.6.1 Low-water Cutoff

Low-water cutoff shall be provided to stop the burner when the water level drops below a predetermined point. It shall consist of a float chamber with float, float switch, and drain valve. The float switch shall be mounted on the float chamber with a packless-type leakproof connection. The float mechanism and drain valve shall be constructed of a corrosion-resistant material. The low-water cutoff shall be UL-06 listed and shall be furnished with approved fittings and installed according to ASME boiler code requirements.

- a. NOT USED
- b. NOT USED

Supplementary Low-Water Cutoff: A supplementary low-water cutoff of the electrically operated probe type or float activated type shall be provided in addition to the low-water cutoff required above on each boiler. Supplementary low-water cutoff shall be mounted directly in the boiler shell and shall be set below the low-water cutoff required above.

##### 2.3.6.2 Water Flow Interlock

Hot water boiler limit controls shall be provided to include protection for low boiler water flow and high boiler water temperature. The limit controls shall

be interlocked with the combustion control system to effect boiler alarm and shutdown. The controls shall not allow boiler startup unless hot water flow is proven.

#### 2.3.6.3 Boiler Combustion Controls and Positioners

- a. Gas boiler units shall be provided with fixed rate (on-off) combustion controls with continuous burning or spark ignited gas pilot.
- b. NOT USED
- c. Fuel control valve shall be controlled by responding to a controller output based on output water temperature.
- d. NOT USED
- e. Fixed rate on-off controls for boilers with capacities up to 2,000,000 Btuh shall use a water temperature controller in a temperature well in direct contact with the water.
- f. NOT USED

#### 2.4 PUMPS

##### 2.4.1 NOT USED

##### 2.4.2 Hot Water and Boiler Circulating Pumps

Circulating pumps for hot water shall be electrically driven single-stage centrifugal type and have a capacity not less than indicated. Boiler circulating pumps shall be supported by the piping on which installed and shall be closed-coupled shaft. Hot water circulating pumps shall be supported by the piping on which installed and shall have a closed-coupled shaft. The pump shaft shall be constructed of corrosion-resistant alloy steel, sleeve bearings and glands of bronze designed to accommodate a mechanical seal, and the housing of close-grained cast iron. Pump seals shall be capable of withstanding 240 degrees F temperature without external cooling. The motor shall have sufficient power for the service required, shall be of a type approved by the manufacturer of the pump, shall be suitable for the available electric service, and shall conform to the requirements of paragraph ELECTRICAL EQUIPMENT. Each pump suction and discharge connection shall be provided with a pressure gauge as specified. The boiler and hot water circulating pump discharge shall be provided with a flow switch or pressure switch. Flow switch unit shall be a self-contained swinging vane type to indicate fluid flow. Pressure switch unit shall be a self-contained snap action type to indicate fluid pressure. Switch shall be a SPDT with 120-volt, 15-ampere rating.

##### 2.4.3 NOT USED

##### 2.4.4 NOT USED

#### 2.5 CONVECTORS

Convectors shall be the type and size indicated. The supply and return connections shall be the same size. Nonferrous convectors shall be tested hydrostatically at the factory and proved tight under a pressure of not less than 100 psig.

Convectors shall be constructed of cast iron or of nonferrous alloys, and shall be installed where indicated. Capacity of convectors shall be as indicated. Overall space requirements for convectors shall not be greater than the space provided. Convectors shall be complete with heating elements and enclosing cabinets having bottom recirculating opening, manual control damper and top supply grille. Convector cabinets shall be constructed of black sheet steel not less than 20 gauge.



#### 2.5.1 Convector Control

The space temperature shall be maintained automatically by regulating water flow to the convectors by self contained, automatic thermostatic radiator control valves.

#### 2.6 NOT USED

#### 2.7 AIR HANDLING UNITS

Air handling units and associated equipment shall be in accordance with Section C-15653 AIR CONDITIONING SYSTEM (UNITARY TYPE).

#### 2.8 FITTINGS AND ACCESSORIES

Boiler fittings and accessories shall be installed with each boiler in accordance with ASME BPV IV, unless otherwise specified.

##### 2.8.1 NOT USED

##### 2.8.2 NOT USED

##### 2.8.3 NOT USED

##### 2.8.4 Stacks

###### 2.8.4.1 NOT USED

###### 2.8.4.2 Stacks

Prefabricated double wall stacks system shall extend above the roof to the height indicated. The inner stack shall be 304 stainless steel having a thickness of not less than 0.035 inch. The outer stack shall be sheet steel having a thickness of not less than 0.025 inch. A method of maintaining concentricity between the inner and outer stacks shall be incorporated. The joints between the stack sections shall be sealed to prevent flue gas leakage. A 0.3125-inch diameter hole shall be provided in the stack not greater than 6 inches from the furnace flue outlet for sampling of the exit gases. Each stack shall be provided complete with rain hood.

##### 2.8.5 Expansion Tank

The hot water pressurization system shall include a diaphragm-type expansion tank which will accommodate the expanded water of the system generated within the normal operating temperature range, limiting the pressure increase at all components in the system to the maximum allowable pressure at those components. The only air in the system shall be the permanent sealed-in air cushion contained in the diaphragm-type tank. The sizes shall be as indicated. The expansion tank shall be welded steel, constructed, tested, and stamped in accordance with ASME BPV VIII Div 1 for a working pressure of 125 psi and precharged to the minimum operating pressure. The tank's air chamber shall be fitted with an air charging valve and pressure gage. The tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations. The tank shall have lifting rings and a drain connection. All components shall be suitable for a maximum operating temperature of 250 degrees F.

##### 2.8.6 Air Separator

External air separation tank shall be steel, constructed, tested and stamped in accordance with ASME BPV VIII Div 1 for a working pressure of 125 psi. The capacity of the air separation tank indicated is minimum.

2.8.7 NOT USED

2.8.8 NOT USED

2.8.9 NOT USED

2.8.10 Steel Sheets

2.8.10.1 Galvanized Steel

Galvanized steel shall be ASTM A 653.

2.8.10.2 Uncoated Steel

Uncoated steel shall be ASTM A 366, composition, condition, and finish best suited to the intended use. Gauge numbers specified refer to manufacturer's standard gauge.

2.8.11 Gaskets

Gaskets shall be nonasbestos material in accordance with ASME B16.21, full face or self-centering type. The gaskets shall be of the spiral wound type with graphite filler material.

2.8.12 Steel Pipe and Fittings

2.8.12.1 Steel Pipe

Steel pipe shall be ASTM A 53, Type E or S, Grade A or B, black steel, standard weight.

2.8.12.2 Steel Pipe Fittings

Fittings shall have the manufacturer's trademark affixed in accordance with MSS SP-25 so as to permanently identify the manufacturer.

2.8.12.3 Steel Flanges

Flanged fittings including flanges, bolts, nuts, bolt patterns, etc. shall be in accordance with ASME B16.5 class 150 and shall have the manufacturers trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105. Flanges for high temperature water systems shall be serrated or raised-face type. Blind flange material shall conform to ASTM A 516 cold service and ASTM A 515 for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193.

2.8.12.4 Welded Fittings

Welded fittings shall conform to ASTM A 234 with WPA marking. Buttwelded fittings shall conform to ASME B16.9, and socket-welded fittings shall conform to ASME B16.11.

2.8.12.5 Cast-Iron Fittings

Fittings shall be ASME B16.4, Class 125, type required to match connecting piping.

#### 2.8.12.6 Malleable-Iron Fittings

Fittings shall be ASME B16.3, type as required to match connecting piping.

#### 2.8.12.7 Unions

Unions shall be ASME B16.39, Class 150.

#### 2.8.12.8 Threads

Pipe threads shall conform to ASME B1.20.1.

#### 2.8.12.9 Grooved Mechanical fittings

Joints and fittings shall be designed for not less than 125 psig service and shall be the product of the same manufacturer. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12; or steel conforming to ASTM A 106, Grade B or ASTM A 53. Gaskets shall be molded synthetic rubber with central cavity, pressure responsive configuration and shall conform to ASTM D 2000, Grade No. 2CA615A15B44F17Z for circulating medium up to 230 degrees F or Grade N0. M3BA610A15B44Z for circulating medium up to 200 degrees F. Grooved joints shall conform to AWWA C606. Coupling nuts and bolts shall be steel and shall conform to ASTM A 183.

#### 2.8.13 Copper Tubing and Fittings

##### 2.8.13.1 Copper Tubing

Tubing shall be ASTM B 88, Type K or L. Adapters for copper tubing shall be brass or bronze for brazed fittings.

##### 2.8.13.2 Solder-Joint Pressure Fittings

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75. Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18 and ASTM B 828.

##### 2.8.13.3 Flared Fittings

Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62.

##### 2.8.13.4 Adapters

Adapters may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used.

##### 2.8.13.5 Threaded Fittings

Cast bronze threaded fittings shall conform to ASME B16.15.

##### 2.8.13.6 Brazing Material

Brazing material shall conform to AWS A5.8.

##### 2.8.13.7 Brazing Flux

Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides, and contain fluorides. Silver brazing materials shall be in accordance with AWS A5.8.

#### 2.8.13.8 Solder Material

Solder metal shall conform to ASTM B 32 95-5 tin-antimony.

#### 2.8.13.9 Solder Flux

Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.

#### 2.8.14 Dielectric Unions

Dielectric unions shall have metal connections on both ends. The ends shall be threaded, flanged, or brazed to match adjacent piping. Metal parts of the union shall be separated so that the electrical current is below 1 percent of the galvanic current which would exist upon metal-to-metal contact.

#### 2.8.15 NOT USED

#### 2.8.16 Pipe Supports

Pipe supports shall conform to MSS SP-58 and MSS SP-69.

#### 2.8.17 NOT USED

#### 2.8.18 Valves

Valves shall be Class 125 and shall be suitable for the application. Grooved ends per AWWA C606 may be used for water service only. Valves in nonboiler external piping shall meet the material, fabrication and operating requirements of ASME B31.1. The connection type of all valves shall match the same type of connection required for the piping on which installed.

##### 2.8.18.1 Gate Valves

Gate valves 2-1/2 inches and smaller shall conform to MSS SP-80 bronze rising stem, threaded, solder, or flanged ends. Gate valves 3 inches and larger shall conform to MSS SP-70 cast iron bronze trim, outside screw and yoke, flanged, or threaded ends.

##### 2.8.18.2 Globe Valves

Globe valves 2-1/2 inches and smaller shall conform to MSS SP-80, bronze, threaded, soldered, or flanged ends. Globe valves 3 inches and larger shall conform to MSS SP-85, cast iron, bronze trim, flanged, or threaded ends.

##### 2.8.18.3 Check Valves

Check valves 2-1/2 inches and smaller shall conform to MSS SP-80, bronze, threaded, soldered, or flanged ends. Check valves 3 inches and larger shall conform to MSS SP-71, cast iron, bronze trim, flanged, or threaded ends.

##### 2.8.18.4 Angle Valves

Angle valves 2-1/2 inches and smaller shall conform to MSS SP-80 bronze, threaded, soldered, or flanged ends. Angle valves 3 inches and larger shall conform to MSS SP-85, cast iron, bronze trim, flanged, or threaded ends.

#### 2.8.18.5 Ball Valves

Ball valves 1/2 inch and larger shall conform to MSS SP-72 OR MSS SP-110, ductile iron or bronze, threaded, soldered, or flanged ends.

#### 2.8.18.6 Plug Valves

Plug valves 2 in. and larger shall conform to MSS SP-78. Plug valves smaller than 2 in. shall conform to ASME B16.34.

#### 2.8.18.7 Grooved End Valves

Valves with grooved ends per AWWA C606 may be used if the valve manufacturer certifies that their performance meets the requirements of the cited MSS standards indicated for each type of valve.

#### 2.8.18.8 Balancing Valves

Balancing valves shall have meter connections with positive shutoff valves. An integral pointer shall register the degree of valve opening. Valves shall be calibrated so that flow in gpm can be determined when valve opening in degrees and pressure differential across valve is known. Each balancing valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation. Valves shall be suitable for 250 degrees F temperature and working pressure of the pipe in which installed. Valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential. One portable differential meter shall be furnished. The meter suitable for the operating pressure specified shall be complete with hoses, vent, and shutoff valves, and carrying case. In lieu of the balancing valve with integral metering connections, a ball valve or plug valve with a separately installed orifice plate or venturi tube may be used for balancing.

#### 2.8.18.9 Automatic Flow Control Valves

In lieu of the specified balancing valves, automatic flow control valves may be provided to maintain constant flow and shall be designed to be sensitive to pressure differential across the valve to provide the required opening. Valves shall be selected for the flow required and provided with a permanent nameplate or tag carrying a permanent record of the factory-determined flow rate and flow control pressure levels. Valves shall control the flow within 5 percent of the tag rating. Valves shall be suitable for the maximum operating pressure of 125 psi or 150 percent of the system operating pressure, whichever is greater. Where the available system pressure is not adequate to provide the minimum pressure differential that still allows flow control, the system pump head capability shall be increased. Valves shall be suitable for 250 degrees F temperature service. Valve materials shall be same as specified for the heating system check, globe, angle, and gate valves. Valve operator shall be the electric motor type or pneumatic type as applicable. Valve operator shall be capable of positive shutoff against the system pump head. Valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential across the automatic flow control valve. A portable meter shall be provided with accessory kit as recommended for the project by the automatic valve manufacturer.

#### 2.8.18.10 Butterfly Valves

Butterfly valves shall be 2 flange type or lug wafer type, and shall be bubbletight at 150 psig. Valve bodies shall be cast iron, malleable iron, or steel. ASTM A 167, Type 404 or Type 316, corrosion resisting steel stems, bronze, or corrosion resisting steel discs, and synthetic rubber seats shall be provided. Valves smaller than 8 inches shall have throttling handles with a minimum of seven locking positions. Valves 8 inches and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators. Valves in insulated lines shall have extended neck to accommodate insulation thickness.

#### 2.8.18.11 Drain valves

Drain valves shall be provided at each drain point of blowdown as recommended by the boiler manufacturer. Piping shall conform to ASME BPV IV and ASTM A 53.

#### 2.8.18.12 Safety Valves

Safety valves shall have steel bodies and shall be equipped with corrosion-resistant trim and valve seats. The valves shall be properly guided and shall be positive closing so that no leakage can occur. Adjustment of the desired back-pressure shall cover the range between 2 and 10 psig. The adjustment shall be made externally, and any shafts extending through the valve body shall be provided with adjustable stuffing boxes having renewable packing. Boiler safety valves of proper size and of the required number, in accordance with ASME BPV IV, shall be installed so that the discharge will be through piping extended to a location as indicated. Each discharge pipe shall be provided with a drip pan elbow to prevent accumulation of water on the valve. A slip joint shall be provided between drip pan elbow and riser.

#### 2.8.18.13 Radiator Valves

Automatic thermostatic radiator valves shall be self-contained direct or remote sensor controlled nonelectric temperature control valves. Valve bodies shall be constructed of chrome plated brass and shall be angle or straight pattern as indicated, with threaded or brazed end connections. Valve disc shall be of ethylene propylene or composition material. Thermostatic operators shall be a modulating type consisting of a sensing unit counter balanced by a spring setting.

#### 2.8.19 Strainers

Basket and "Y" type strainers shall be the same size as the pipelines in which they are installed. The strainer bodies shall be heavy and durable, fabricated of cast iron, and shall have bottoms drilled and tapped with a gate valve attached for blowdown purposes. Strainers shall be designed for 125 psig service and 200 degrees F. The bodies shall have arrows clearly cast on the sides indicating the direction of flow. Each strainer shall be equipped with an easily removable cover and sediment screen. The screen shall be made of 22 gauge brass sheet or corrosion-resistant steel with small perforations numbering not less than 400 per square inch to provide a net free area through the basket of at least 3.30 times that of the entering pipe. The flow shall be into the screen and out through the perforations.

#### 2.8.20 Pressure Gauges

Gauges shall conform to ASME B40.1 and shall be provided with throttling type needle valve or a pulsation dampener and shutoff valve. Minimum dial size shall

be 3-1/2 inches. A pressure gauge shall be provided for each boiler in a visible location on the boiler.

#### 2.8.21 Thermometers

Thermometers shall be provided with wells and separable corrosion-resistant steel sockets. Thermometers for inlet water and outlet water for each hot water boiler shall be provided in a visible location on the boiler. Thermometers shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a minimum 9 inch scale.

#### 2.8.22 Air Vents

##### 2.8.22.1 Manual Air Vents

Manual air vents shall be brass or bronze valves or cocks suitable for the pressure rating of the piping system and furnished with threaded plugs or caps.

##### 2.8.22.2 Automatic Air Vents

Automatic air vents shall be 3/4 inch quick-venting float and vacuum air valves. Each air vent valve shall have a large port permitting the expulsion of the air without developing excessive back pressure, a noncollapsible metal float which will close the valve and prevent the loss of water from the system, an air seal that will effectively close and prevent the re-entry of air into the system when subatmospheric pressures prevail therein. The name of the manufacturer shall be clearly stamped on the outside of each valve. The air vent valve shall be suitable for the pressure rating of the piping system.

#### 2.8.23 NOT USED

#### 2.8.24 FLOW METERS

Meters shall measured flow based on pressure differential across an internal nozzle. Self-contained gauge type unit shall have bronze body and internal components, BUNA-N seals, and 3 1/2" dial face with black lettering on white background. Scale range shall place design flow rate at its approximate midpoint.

### 2.9 ELECTRICAL EQUIPMENT

Electric motor-driven equipment shall be provided complete with motors, motor starters, and all necessary control devices. Electrical equipment, motor control devices, motor efficiencies and wiring shall be as specified in Section C-16415 ELECTRICAL WORK, INTERIOR. Motors which are not an integral part of a packaged boiler shall be rated for standard efficiency service. Motors which are an integral part of the packaged boiler shall be the highest efficiency available by the manufacturer of the packaged boiler. Motor starters shall be provided complete with properly sized thermal overload protections and other appurtenances necessary for the motor control specified. Starters shall be furnished in general purpose enclosures. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices but not shown shall be provided.

#### 2.9.1 Motor Ratings

Motors shall be suitable for the voltage and frequency provided. Motors 1/2 hp and larger shall be three-phase, unless otherwise indicated. Motors shall be of

sufficient capacity to drive the equipment at the specified capacity without exceeding the nameplate rating on the motor.

#### 2.9.2 Motor Controls

Motor controllers shall be provided complete with properly sized thermal overload protection. Manual or automatic control and protective or signal devices required for the operation specified and any wiring required to such devices shall be provided. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers may be provided to accomplish the same function. Solid state variable speed controllers shall be utilized for fractional through 10 hp ratings. Adjustable frequency drives shall be used for larger motors.

#### 2.10 INSULATION

Shop and field-applied insulation shall be as specified in Section C-15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

#### 2.11 TOOLS

Special tools shall be furnished. Special tools shall include all uncommon tools necessary for the operation and maintenance of boilers, burners, pumps, fans, controls, meters, special piping systems, and other equipment. Small hand tools shall be furnished within a suitable cabinet mounted where directed.

##### 2.11.1 NOT USED

##### 2.11.2 NOT USED

##### 2.11.3 NOT USED

##### 2.11.4 Wrenches

Wrenches shall be provided as required for specialty fittings such as manholes, handholes, and cleanouts. One set of extra gaskets shall be provided for all manholes and handholes, for pump barrels, and other similar items of equipment. All gaskets shall be packaged and properly identified.

##### 2.12 NOT USED

##### 2.13 NOT USED

##### 2.13.1 NOT USED

##### 2.13.2 NOT USED

##### 2.13.3 NOT USED

##### 2.13.4 NOT USED

##### 2.13.5 NOT USED

##### 2.13.6 NOT USED

##### 2.13.7 NOT USED

##### 2.13.8 NOT USED

##### 2.13.9 NOT USED



#### 2.13.10 Chemical Shot Feeder

A shot feeder shall be provided as indicated. Size and capacity of feeder shall be based upon local requirements and water analysis. The feeder shall be furnished with an air vent, gauge glass, funnel, valves, fittings, and piping.

#### 2.13.11 NOT USED

#### 2.13.12 NOT USED

### PART 3 EXECUTION

#### 3.1 ERECTION OF BOILER AND AUXILIARY EQUIPMENT

Boiler and auxiliary equipment shall be installed in accordance with manufacturers' written instructions.

#### 3.2 PIPING INSTALLATION

Unless otherwise specified, nonboiler external pipe and fittings shall conform to the requirements of ASME B31.1. Pipe installed shall be cut accurately to suit field conditions, shall be installed without springing or forcing, and shall properly clear windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted. Pipes shall be free of burrs, oil, grease and other foreign material and shall be installed to permit free expansion and contraction without damaging the building structure, pipe, pipe joints, or pipe supports. Changes in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted provided a pipe bender is used and wide sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. Vent pipes shall be carried through the roof as directed and shall be properly flashed. Unless otherwise indicated, horizontal supply mains shall pitch down in the direction of flow with a grade of not less than 1 inch in 40 feet. Open ends of pipelines and equipment shall be properly capped or plugged during installation to keep dirt or other foreign materials out of the systems. Pipe not otherwise specified shall be uncoated. Unless otherwise specified or shown, final connections to equipment shall be made with malleable-iron unions for steel pipe 2-1/2 inches or less in diameter and with flanges for pipe 3 inches or more in diameter. Unions for copper pipe or tubing shall be brass or bronze. Reducing fittings shall be used for changes in pipe sizes. In horizontal hot water lines reducing fittings shall be eccentric type to maintain the top of the lines at the same level to prevent air binding.

##### 3.2.1 Cold Water Connections

Cold water fill connections shall be made to the water supply system as indicated. Necessary pipe, fittings, and valves required for water connections between the boiler and cold water main shall be provided as shown. The pressure regulating valve shall be of a type that will not stick or allow pressure to build up on the low side. The valve shall be set to maintain a terminal pressure of approximately 5 psi in excess of the static head on the system and shall operate within a 2 psi tolerance regardless of cold water supply piping pressure and without objectionable noise under any condition of operation.

##### 3.2.2 Hot Water Piping and Fittings

Pipe shall be black steel or copper tubing. Fittings for steel piping shall be black malleable iron or cast iron to suit piping. Fittings adjacent to valves shall suit valve material.

### 3.2.3 Vent Piping and Fittings

Vent piping shall be black steel. Fittings shall be black malleable iron or cast iron to suit piping.

### 3.2.4 Gauge Piping

Piping shall be copper tubing.

### 3.2.5 NOT USED

### 3.2.6 NOT USED

### 3.2.7 Joints

Joints between sections of steel pipe and between steel pipe and fittings shall be threaded, grooved, flanged or welded as indicated or specified. Except as otherwise specified, fittings 1 inch and smaller shall be threaded; fittings 1-1/4 inches and up to but not including 3 inches shall be either threaded, grooved, or welded; and fittings 3 inches and larger shall be either flanged, grooved, or welded. Pipe and fittings 1-1/4 inches and larger installed in inaccessible conduit or trenches beneath concrete floor slabs shall be welded. Connections to equipment shall be made with black malleable-iron unions for pipe 2-1/2 inches or smaller in diameter and with flanges for pipe 3 inches or larger in diameter. Joints between sections of copper tubing or pipe shall be flared or brazed.

#### 3.2.7.1 Threaded Joints

Threaded joints shall be made with tapered threads properly cut and shall be made perfectly tight with a stiff mixture of graphite and oil or with polytetrafluoroethylene tape applied to the male threads only and in no case to the fittings.

#### 3.2.7.2 Welded Joints

Welded joints shall be in accordance with paragraph GENERAL REQUIREMENTS unless otherwise specified. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connections may be made with either welding tees or forged branch outlet fittings, either being acceptable without size limitation. Branch outlet fittings, where used, shall be forged, flared for improved flow characteristics where attached to the run, reinforced against external strains, and designed to withstand full pipe bursting strength. Socket weld joints shall be assembled so that the space between the end of the pipe and the bottom of the socket is no less than 1/16 inch or no more than 1/8 inch.

#### 3.2.7.3 Grooved Mechanical Joints

Grooved mechanical joints may be provided for hot water systems in lieu of unions, welded, flanged, or screwed piping connections in low temperature hot water systems where the temperature of the circulating medium does not exceed 230 degrees F. Grooves shall be prepared according to the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, or narrow-land micrometer. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be

used in concealed locations. Mechanical joints shall use rigid mechanical pipe couplings, except at equipment connections. At equipment connections, flexible couplings may be used. Coupling shall be of the bolted type for use with grooved end pipes, fittings, valves, and strainers. Couplings shall be self-centering and shall engage in a watertight couple.

#### 3.2.7.4 Flared and Brazed Copper Pipe and Tubing

Tubing shall be cut square, and burrs shall be removed. Both inside of fittings and outside of tubing shall be cleaned thoroughly with sand cloth or steel wire brush before brazing. Annealing of fittings and hard-drawn tubing shall not occur when making connections. Installation shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA 404/0 RR with flux. Copper-to-copper joints shall include the use of copper-phosphorous or copper-phosphorous-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorous, copper-phosphorous-silver or a silver brazing filler metal. Joints for flared fittings shall be of the compression pattern. Swing joints or offsets shall be provided in all branch connections, mains, and risers to provide for expansion and contraction forces without undue stress to the fittings or to short lengths of pipe or tubing. Flared or brazed copper tubing to pipe adapters shall be provided where necessary for joining threaded pipe to copper tubing.

#### 3.2.7.5 Soldered Joints

Soldered joints shall be made with flux and are only acceptable for lines 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA 404/0 RR.

#### 3.2.7.6 Copper Tube Extracted Joint

An extruded mechanical tee joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. The branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Extracted joints shall be brazed using a copper phosphorous classification brazing filler metal. Soldered joints will not be permitted.

#### 3.2.8 Flanges and Unions

Flanges shall be faced true, provided with 1/16 inch thick gaskets, and made square and tight. Where steel flanges mate with cast-iron flanged fittings, valves, or equipment, they shall be provided with flat faces and full face gaskets. Union or flange joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items. Dielectric pipe unions shall be provided between ferrous and nonferrous piping to prevent galvanic corrosion. The dielectric unions shall have metal connections on both ends. The ends shall be threaded, flanged, or brazed to match adjacent piping. The metal parts of the union shall be separated so that the electrical current is below 1 percent of the galvanic current which would exist upon metal-to-metal contact. Gaskets, flanges, and unions shall be installed in accordance with manufacturer's recommendations.

### 3.2.9 Branch Connections

#### 3.2.9.1 Branch Connections for Hot Water Systems

Branches from the main shall pitch up or down as shown to prevent air entrapment. Connections shall be carefully made to ensure unrestricted circulation, eliminate air pockets, and permit complete drainage of the system. Branches shall pitch with a grade of not less than 1 inch in 10 feet. When indicated, special flow fittings shall be installed on the mains to bypass portions of the water through each radiator. Special flow fittings shall be standard catalog products and shall be installed as recommended by the manufacturer.

#### 3.2.9.2 NOT USED

#### 3.2.10 NOT USED

#### 3.2.11 NOT USED

#### 3.2.12 NOT USED

#### 3.2.13 Flared, Brazed, and Soldered Copper Pipe and Tubing

Copper tubing shall be flared, brazed, or soldered. Tubing shall be cut square, and burrs shall be removed. Both inside of fittings and outside of tubing shall be cleaned thoroughly with sand cloth or steel wire brush before brazing. Care shall be taken to prevent annealing of fittings and hard-drawn tubing when making connections. Installation shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints for flared fittings shall be of the compression pattern. Swing joints or offsets shall be provided on all branch connections, mains, and risers to provide for expansion and contraction forces without undue stress to the fittings or to short lengths of pipe or tubing. Pipe adapters shall be provided where necessary for joining threaded pipe to copper tubing. Brazed joints shall be made in conformance with MSS SP-73, and CDA 404/0-RR. Copper to copper joints shall include the use of copper-phosphorous or copper-phosphorous-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorous, copper-phosphorous-silver, or a silver brazing filler metal. Soldered joints shall be made with flux and are only acceptable for lines 2 inches or smaller. Soldered joints shall conform to ASME B31.5 and shall be in accordance with CDA 404/0-RR.

#### 3.2.14 Copper Tube Extracted Joint

An extracted mechanical tee joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. The branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Extracted joints shall be brazed using a copper phosphorous classification brazing filler metal. Soldered joints shall not be permitted.

#### 3.2.15 Supports

##### 3.2.15.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the

expansion movement, and to prevent buckling, swaying, and undue strain. All piping subjected to vertical movement when operating temperatures exceed ambient temperatures, shall be supported by variable spring hangers and supports or by constant support hangers.

### 3.2.15.2 Seismic Requirements for Supports and Structural Bracing

Piping and attached valves shall be supported and braced to resist seismic loads as specified in Section C-13080 SEISMIC PROTECTION FOR MECHANICAL, ELECTRICAL EQUIPMENT. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, shall be provided in this section. Material used for supports shall be as specified in Section C-05120 STRUCTURAL STEEL.

### 3.2.15.3 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

- a. Types 5, 12, and 26 shall not be used.
- b. Type 3 shall not be used on insulated pipe which has a vapor barrier. Type 3 may be used on insulated pipe that does not have a vapor barrier if clamped directly to the pipe, if the clamp bottom does not extend through the insulation, and if the top clamp attachment does not contact the insulation during pipe movement.
- c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for Type 18 inserts.
- d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices furnished by the manufacturer. Field fabricated C-clamp bodies or retaining devices are not acceptable.
- e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- g. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves.
- h. Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers, and at vent terminations.
- i. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

(1) Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inches and larger, a Type 39 saddle may be welded to the pipe and freely rested on a steel plate. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rested on a steel slide plate.

(2) Where there are high system temperatures and welding to piping is not desirable, the Type 35 guide shall include a pipe cradle welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

j. Except for Type 3, pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation.

k. Piping in trenches shall be supported as indicated.

l. Structural steel attachments and brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material and installation shall be as specified under Section C-05120 STRUCTURAL STEEL. Pipe hanger loads suspended from steel joist between panel points shall not exceed 50 pounds. Loads exceeding 50 pounds shall be suspended from panel points.

#### 3.2.15.4 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support member shall not exceed the hanger and support spacing required for any individual pipe in the multiple pipe run. The clips or clamps shall be rigidly attached to the common base member. A clearance of 1/8 inch shall be provided between the pipe insulation and the clip or clamp for all piping which may be subjected to thermal expansion.

#### 3.2.16 Anchors

Anchors shall be provided wherever necessary to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results, using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline.

#### 3.2.17 Valves

Valves shall be installed where indicated, specified, and required for functioning and servicing of the systems. Valves shall be safely accessible. Swing check valves shall be installed upright in horizontal lines and in vertical lines only when flow is in the upward direction. Gate and globe valves shall be installed with stems horizontal or above. Valves to be brazed shall be disassembled prior to brazing and all packing removed. After brazing, the valves shall be allowed to cool before reassembling.

#### 3.2.18 Pipe Sleeves

Pipe passing through concrete or masonry walls or concrete floors shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall not be installed in structural members. Sleeves through walls shall be cut flush with wall surface. Sleeves through floors shall be cut flush with floor surface or extend above top surface of floor a sufficient distance to allow proper flashing or finishing. Unless otherwise indicated, sleeves shall be sized to provide a minimum clearance of 1/4 inch between bare pipe and sleeves or between jacket over insulation and sleeves. Sleeves in waterproofing membrane floors, bearing walls, and wet areas shall be galvanized steel pipe or cast-iron pipe. Sleeves in nonbearing walls, floors, or ceilings may be galvanized steel pipe, cast-iron pipe, or galvanized sheet metal with lock-type longitudinal seam. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over insulation and sleeve in nonfire rated walls shall be sealed as indicated and specified in Section C-07920 CAULKING AND SEALANTS. Metal jackets shall be provided over insulation passing through exterior walls, firewalls, fire partitions, or floors, shall not be thinner than 0.006 inch thick aluminum, if corrugated, and 0.016 inch thick aluminum, if smooth, and shall be secured with aluminum or stainless steel bands not less than 3/8 inch wide and

not more than 8 inches apart. The metal jacket shall extend from a point below the backup material to a point 12 inches above material to a minimum distance of 2 inches above the flashing. For other areas, the metal jacket shall extend from a point below the backup material to a point 12 inches above the floor; when passing through walls above grade, the jacket shall extend at least 4 inches beyond each side of the wall.

3.2.18.1 NOT USED

3.2.18.2 NOT USED

3.2.18.3 NOT USED

3.2.18.4 Fire Seal

Where pipes pass through firewalls, fire partitions, or floors, a fire seal shall be provided as specified in Section C-07270 FIRESTOPPING.

3.2.19 Balancing Valves

Balancing valves shall be installed as indicated.

3.2.20 Thermometer Wells

A thermometer well shall be provided in each return line for each circuit in multicircuit systems.

3.2.21 Air Vents

Air vents shall be installed where shown or directed. Air vents shall be installed in piping at all system high points. The vent shall remain open until water rises in the tank or pipe to a predetermined level at which time it shall close tight. An overflow pipe from the vent shall be run to a point designated by the Contracting Officer's representative. The inlet to the air vent shall have a gate valve or ball valve.

3.2.22 Escutcheons

Escutcheons shall be provided at all finished surfaces where exposed piping, bare or insulated, passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be chromium-plated iron or chromium-plated brass, either one-piece or split pattern, held in place by internal spring tension or setscrews.

3.2.23 Drains

A drain connection with a 1 inch gate valve or 3/4 inch hose bib shall be installed at the lowest point in the return main near the boiler. In addition, threaded drain connections with threaded cap or plug shall be installed on the heat exchanger coil on each unit heater or unit ventilator and wherever required for thorough draining of the system.

3.2.24 Strainer Blow-Down Piping

Strainer blow-down connections shall be fitted with a black steel blow-down pipeline routed to an accessible location and provided with a blow-down valve.

3.3 GAS FUEL SYSTEM

Gas piping, fittings, valves, regulators, tests, cleaning, and adjustments shall be in accordance with the Section C-15488 GAS PIPING SYSTEMS. All requirements of NFPA 54 shall be complied with unless otherwise specified herein. Burners, pilots, and all accessories shall conform to requirements of UL-06. The fuel system shall be provided with a gas tight, manually operated, UL listed stop valve at the gas-supply connections, a gas strainer, a pressure regulator, pressure gauges, a burner-control valve, a safety shutoff valve suitable for size of burner and sequence of operation, and all other components required for safe, efficient, and reliable operation as hereinbefore specified. Approved permanent and ready facilities to permit periodic valve leakage tests on the safety shutoff valve or valves shall be provided.

### 3.4 NOT USED

### 3.5 FIELD PAINTING

Ferrous metal not specified to be coated at the factory shall be cleaned, prepared, and painted as specified in Section C-09900 PAINTING, GENERAL. Exposed pipe covering shall be painted as specified in Section C-09900 PAINTING, GENERAL. Aluminum sheath over insulation shall not be painted.

### 3.6 HEATING SYSTEM TESTS

Before any covering is installed on pipe or heating equipment, the entire heating system's piping, fittings, and terminal heating units shall be hydrostatically tested and proved tight at a pressure of 1-1/2 times the design working pressure. Before pressurizing system for test, blank off or replace with spool pieces items or equipment (e.g., vessels, pumps, instruments, controls, relief valves) rated for pressures below the test pressure. Before balancing and final operating test, remove test blanks and spool pieces; and reconnect protected instruments and equipment. With equipment items protected, pressurize the system to test pressure. Hold pressure for a period of time sufficient to inspect all welds, joints, and connections for leaks, but in no case less than 2 hours. No loss of pressure shall be allowed. Repair leaks and retest repaired joints. Caulking of joints shall not be permitted. Drain system and, after instruments and equipment are reconnected, refill system with service medium and apply maximum operating pressure. Hold pressure while inspecting these joints and connections for leaks. Repair leaks and retest repaired joints. Upon completion of hydrostatic tests and before acceptance of the installation, the Contractor shall balance the heating system in accordance with Section C-15990 TESTING ADJUSTING AND BALANCING OF HVAC SYSTEMS and perform the operating tests required to demonstrate satisfactory functional and operational efficiency. The operating test shall cover a period of at least 24 hours for each system, and shall include, as a minimum, the following specific information in a report together with conclusions as to the adequacy of the system:

- a. Certification of balancing.
- b. Time, date, and duration of test.
- c. Outside and inside dry bulb temperatures.
- d. Temperature of hot water supply leaving boiler.
- e. Temperature of heating return water from system at boiler inlet.
- f. Quantity of water feed to boiler.
- g. Boiler make, type, serial number, design pressure, and rated capacity.
- h. Fuel burner make, model, and rated capacity.
- i. Circulating pump make, model, and rated capacity, and ammeter and voltmeter readings for pump motor during operation.
- j. Flue-gas temperature at boiler outlet.
- k. Percent carbon dioxide in flue-gas.
- l. Grade or type and calorific value of fuel.
- m. Draft at boiler flue-gas exit.
- n. Draft or pressure in furnace.



- o. Quantity of water circulated.
- p. Quantity of fuel consumed.
- q. NOT USED

#### 3.6.1 NOT USED

### 3.7 CLEANING

#### 3.7.1 Boilers and Piping

After the hydrostatic tests have been made and before the system is balanced and operating tests are performed, the boilers and feed water piping shall be thoroughly cleaned by filling the system with a solution consisting of either 1 pound of caustic soda or 1 pound of trisodium phosphate per 50 gallons of water. Observe the proper safety precautions in the handling and use of these chemicals. The water shall be heated to approximately 150 degrees F and the solution circulated in the system for a period of 48 hours. The system shall then be drained and thoroughly flushed out with fresh water. Strainers and valves shall be thoroughly cleaned. Prior to operating tests, air shall be removed from all water systems by operating the air vents.

#### 3.7.2 Heating Units

Inside space heating equipment, ducts, plenums, and casing shall be thoroughly cleaned of all debris and blown free of all small particles of rubbish and dust and then shall be vacuum cleaned before installing outlet faces. Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building, and the ducts, plenum, casings, and other items specified have been vacuum cleaned. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

### 3.8 FUEL SYSTEM TESTS

#### 3.8.1 NOT USED

#### 3.8.2 Gas System Test

The gas fuel system shall be tested in accordance with the test procedures outlined in NFPA 54.

### 3.9 FIELD TRAINING

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 12 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the operating and maintenance instructions, as well as demonstrations of routine maintenance operations. The Contracting Officer shall be notified at least 14 days prior to date of proposed conduction of the training course.

-- End of Section --

## SECTION C-15653

### REFRIGERANT SYSTEM (UNITARY TYPE)

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

#### AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 460	(1994) Remote Mechanical-Draft Air-Cooled Refrigerant Condensers
ARI 495	(1993) Refrigerant Liquid Receivers
ARI 710	(1986) Liquid-Line Driers
ARI 720	(1988) Refrigerant Access Valves and Hose Connectors
ARI 750	(1987) Thermostatic Refrigerant Expansion Valves
ARI 760	(1987) Solenoid Valves for Use with Volatile Refrigerants

#### AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A13.1	(1981; R 1993) Scheme for the Identification of Piping Systems
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#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1995a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM 334	(1991) Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service
ASTM A 525	(1993) General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM B 117	(1994) Salt Spray (Fog) Testing
ASTM B 280	(1993a) Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM C 534	(1994) Preformed Flexible Elastomeric Cellular thermal Insulation in Sheet and tubular Form
ASTM D 520	(1984; R 1989) Zinc Dust Pigment
ASTM D 3308	(1991a) PTFE Resin Skived Tape
ASTM F 104	(1993) Nonmetallic Gasket Materials

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING  
ENGINEERS (ASHRAE)

ASHRAE 15 (1994) Safety Code for Mechanical Refrigeration

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.1 (1992; B31.1a; B31.1b; B31.1c) Power Piping.

ASME B31.5 (1992; B31.5a) Refrigeration Piping

ASME B40.1 (1991) Gauges - Pressure Indicating Dial Type - Elastic  
Element

ASME BPV VIII Div 1 (1995; Addenda Dec 1995) Boiler and Pressure Vessel Code;  
Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASME BPV IX (1995; Addenda Dec 1995) Boiler and Pressure Vessel Code;  
Section IX, Welding and Brazing Qualifications

AMERICAN WELDING SOCIETY (AWS)

AWS-01 (1991) Brazing Handbook

FEDERAL SPECIFICATIONS (FS)

FS QQ-B-654 (Rev A; Am 1; Notice 1) Brazing Alloys, Silver

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS  
INDUSTRY (MSS)

MSS SP-58 (1993) Pipe Hangers and Supports - Materials, Design and  
Manufacture

MSS SP-69 (1991) Pipe Hangers and Supports - Selection and  
Application

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6 (1993) Enclosures for Industrial Control and Systems

NEMA MG 1 (1993; Rev 1-1993) Motors and Generators

NEMA MG 2 (1989; Rev 1) Safety Standard for Construction and Guide  
for Selection, Installation, and Use of Electric Motors  
and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 207 (1993; Rev thru Mar 1995) Refrigerant-Containing  
Components and Accessories, Nonelectrical

UL 1995 (1995) Heating and Cooling Equipment

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

#### SD-01 Data

Refrigerant System; GA.

Manufacturer's standard catalog data, prior to the purchase or installation of a particular component, shall be highlighted to show brand name, model number, size, options, performance charts and curves, etc. in sufficient detail to demonstrate compliance with contract requirements. Data shall be submitted for each specified component. Data shall include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, vibration isolator literature shall be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations.

Spare Parts Data; FIO.

Spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 3 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

#### SD-04 Drawings

Refrigerant System; GA.

Drawings shall provide adequate detail to demonstrate compliance with contract requirements. Drawings shall consist of:

- (1) Equipment layouts which identify assembly and installation details.
- (2) Piping layouts which identify valves and fittings.
- (3) Plans and elevations which identify clearances required for maintenance and operation.
- (4) Wiring diagrams which identify each component individually and interconnected or interlocked relationships between components.
- (5) Foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for equipment indicated or required to have concrete foundations.
- (6) Details, if piping and equipment are to be supported other than as indicated, which include loadings and type of frames, brackets, stanchions, or other supports.
- (7) Automatic temperature control diagrams and control sequences.
- (8) Installation details which includes the amount of factory set superheat and corresponding refrigerant pressure/temperature.

#### SD-06 Instructions

Framed Instructions; FIO.

Framed instructions for posting, at least 2 weeks prior to construction completion.

#### SD-07 Schedules

Tests; FIO.

A letter, at least 10 working days in advance of each tests, advising the Contracting Officer of the test. Individual letters shall be submitted for the refrigerant system and the system performance tests. Each letter shall identify the date, time, and location for each test.

Demonstrations; GA.

A letter, at least 14 working days prior to the date of the proposed training course, which identifies the date, time, and location for the training.

#### SD-08 Statements

Qualifications; GA.

A letter listing the qualifying procedures for each welder. The letter shall include supporting data such as test procedures used, what was tested etc., and a list of the names of qualified welders and their identification symbols.

Verification of Dimensions; FIO.

A letter, at least 2 weeks prior to beginning construction, including the date the site was visited, conformation of existing conditions, and any discrepancies found.

#### SD-09 Reports

Tests; GA.

Six copies of each test containing the information described below in bound 8-1/2 by 11 inch booklets. Individual report shall be submitted for the refrigerant system test.

- (1) The date the tests were performed.
- (2) A list of equipment used, with calibration certifications.
- (3) Initial test summaries.
- (4) Repairs/adjustments performed.
- (5) Final test results.

System Performance Tests; GA.

Six copies of the report shall be provided in bound 8-1/2 by 11 inch booklets. The report shall document compliance with the specified performance criteria upon completion and testing of the system. The report shall indicate the number of days covered by the tests and any conclusions as to the adequacy of the system. The report shall also include the following information and shall be taken at least three different times at outside dry-bulb temperatures that are at least 5 degrees F apart:

- (1) Date and outside weather conditions.
- (2) The load on the system based on the following:
  - (a) The refrigerant used in the system.
  - (b) Condensing temperature and pressure.
  - (c) Suction temperature and pressure.
  - (d) Ambient, condensing temperatures

- (e) Running current, voltage and proper phase sequence for each phase of all motors.
- (3) The actual on-site setting of operating and safety controls.
- (4) Thermostatic expansion valve superheat - value as determined by field test
- (5) Subcooling
- (6) High and low refrigerant temperature switch set-points
- (7) Low oil pressure switch set-point
- (8) Defrost system timer and thermostat set-points
- (9) Moisture content
- (10) Capacity control set-points
- (11) Field data and adjustments which affect unit performance and energy consumption.
- (12) Field adjustments and settings which were not permanently marked as an integral part of a device.

#### SD-13 Certificates

##### Refrigerant System; FIO.

Where the system, components, or equipment are specified to comply with requirements of ARI, ASHRAE, ASME, or UL, proof of such compliance shall be provided. The label or listing of the specified agency shall be acceptable evidence. In lieu of the label or listing, a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency may be submitted. When performance requirements of this project's drawings and specifications vary from standard ARI rating conditions, computer printouts, catalog, or other application data certified by ARI or a nationally recognized laboratory as described above shall be included. If ARI does not have a current certification program that encompasses such application data, the manufacturer may self certify that his application data complies with project performance requirements in accordance with the specified test standards.

##### Service Organizations; FIO.

A certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. The service organizations shall be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

#### SD-19 Operation and Maintenance Manuals

##### Operation Manual; FIO.

Six complete copies of an operation manual in bound 8-1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, and shutdown. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

##### Maintenance Manual; FIO.

Six complete copies of maintenance manual in bound 8-1/2 by 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a

trouble shooting guide. The manuals shall include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

### 1.3 QUALIFICATIONS

Piping shall be welded in accordance with the qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests and the tests shall be performed at the work site if practical. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section C-05055 WELDING, STRUCTURAL.

### 1.4 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather and contamination. Proper protection and care of all material before, during, and after installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

### 1.5 PROJECT/SITE CONDITIONS

#### 1.5.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

#### 1.5.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions. Equipment and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record shall be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations.

## 2.2 NAMEPLATES

Major equipment including condensing units, receivers, and motors shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates shall be durable and legible throughout equipment life and made of anodized aluminum. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

## 2.3 ELECTRICAL WORK

Electrical equipment, motors, motor efficiencies, and wiring shall be in accordance with Section C-16415 ELECTRICAL WORK, INTERIOR. Electrical motor driven equipment specified shall be provided complete with motors, motor starters, and controls. Electrical characteristics shall be as shown, and unless otherwise indicated, all motors of 1 horsepower and above shall be high efficiency type. Field wiring shall be in accordance with manufacturer's instructions. Each motor shall conform to NEMA MG 1 and NEMA MG 2 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Motors shall be continuous duty with the enclosure specified. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors shall be furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motors shall be sized for the applicable loads. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of enclosure. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

## 2.4 MISCELLANEOUS MATERIALS

### 2.4.1 Gaskets

Gaskets shall conform to ASTM F 104 - classification for compressed sheet with nitrile binder and acrylic fibers for maximum 700 degrees F service.

### 2.4.2 Bolts and Nuts

Bolts and nuts, except as required for piping applications, shall be in accordance with ASTM A 307. The bolt head shall be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A 307.

### 2.4.3 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

### 2.4.4 NOT USED

### 2.4.5 Pressure and Vacuum Gauge

Gauge shall conform to ASME B40.1, Class 1, 2, or 3, Style X, Type I or III as required, 4-1/2 inches in diameter with phenolic or metal case. Each gauge range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.



#### 2.4.6 Temperature Gauges

Industrial duty thermometers shall be provided for the required temperature range. Thermometers shall have Fahrenheit scale in 2 degree graduations scale on a white face. The pointer shall be adjustable.

##### 2.4.6.1 Stem Cased-Glass

Stem cased-glass case shall be polished stainless steel or cast aluminum, 9 inches long, with clear acrylic lens, and non-mercury filled glass tube.

##### 2.4.6.2 Bimetallic Dial

Bimetallic dial type case shall be not less than 3-1/2 inches, stainless steel, and shall be hermetically sealed with clear acrylic lens. Bimetallic element shall be silicone dampened and unit fitted with external calibrator adjustment. Accuracy shall be one percent of dial range.

##### 2.4.6.3 Liquid-, Solid-, and Vapor-Filled Dial

Liquid-, solid-, and vapor-filled dial type cases shall be not less than 3-1/2 inches, stainless steel or cast aluminum with clear acrylic lens. Fill shall be nonmercury, suitable for encountered cross-ambients, and connecting capillary tubing shall be double-braided bronze.

##### 2.4.6.4 Thermal Well

Thermal well shall be identical size, 1/2 or 3/4 inch NPT connection, brass or stainless steel. Where test wells are indicated, provide captive plug-fitted type 1/2 inch NPT connection suitable for use with either engraved stem or standard separable socket thermometer or thermostat. Extended neck thermal wells shall be of sufficient length to clear insulation thickness by 1 inch.

#### 2.4.7 Unicellular Plastic Foam

Unicellular plastic foam shall be in accordance with ASTM C 534, Form T, except that D-Factor shall not exceed 0.28 at 75 degrees F mean temperature.

#### 2.4.8 NOT USED

#### 2.5 NOT USED

#### 2.6 NOT USED

#### 2.7 NOT USED

#### 2.8 NOT USED

#### 2.9 REMOTE CONDENSING UNIT

Each remote condenser coil shall be fitted with a manual isolation valve and an access valve on the coil side. Saturated refrigerant condensing temperature shall not exceed 120 degrees F at 95 degrees F ambient. Unit shall be provided with condenser controls to ensure proper operation in an ambient temperature of 40 degrees F. Fan and cabinet construction shall be provided as specified in paragraph "System Components". Fan and condenser motors shall have totally enclosed enclosures.

### 2.9.1 Air-Cooled Condenser

Unit shall be rated in accordance with ARI 460 and conform to the requirements of UL 1995. Unit shall be factory fabricated, tested, packaged, and self-contained. Unit shall be complete with casing, propeller or centrifugal type fans, heat rejection coils, connecting piping and wiring, and all necessary appurtenances.

#### 2.9.1.1 Connections

Interconnecting refrigeration piping, electrical power, and control wiring between the condensing unit and the indoor unit shall be provided as required and as indicated. Electrical and refrigeration piping terminal connections between condensing unit and evaporator units shall be provided.

#### 2.9.1.2 Head Pressure Control and Liquid Subcooling

Controls shall be set to produce a minimum of 95 degrees F saturated refrigerant condensing temperature. Unit shall be provided with a liquid subcooling circuit which shall ensure proper liquid refrigerant flow to the expansion device over the specified application range of the condenser. Unit shall be provided with manufacturer's standard liquid subcooling. Subcooling circuit shall be liquid sealed.

#### 2.9.1.3 Condensing Coil

Coils shall have nonferrous tubes of 3/8 inch minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Casing shall be galvanized steel or aluminum. Contact of dissimilar metals shall be avoided. Coils shall be tested in accordance with ASHRAE 15 at the factory and be suitable for the working pressure of the installed system. Each coil shall be dehydrated and sealed after testing and prior to evaluation and charging. Each unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge. Unit shipped with a holding charge shall be field charged. Separate expansion devices shall be provided for each compressor circuit.

#### 2.9.1.4 Unit Controls

The control system shall be complete with required accessories for regulating condenser pressure by fan cycling, solid-state variable fan speed, modulating condenser coil or fan dampers, flooding the condenser, or a combination of the above. Unit mounted control panels or enclosures shall be constructed in accordance with applicable requirements of NFPA 70 and housed in NEMA ICS 6, Class 1 or 3A enclosures. Controls shall include control transformer, fan motor starters, overload protective devices, interface with local and remote components, and intercomponent wiring to terminal block points.

### 2.9.2 NOT USED

### 2.9.3 Compressor

Compressor shall be direct drive, semi-hermetic or hermetic reciprocating, or scroll type capable of operating at partial load conditions. Compressor shall be capable of continuous operation down to the lowest step of unloading as specified. Units 10 tons and larger shall be provided with capacity reduction devices to produce automatic capacity reduction of at least 50 percent. If standard with the manufacturer, two or more compressors may be used in lieu of a single compressor with unloading capabilities, in which case the compressors

will operate in sequence, and each compressor shall have an independent refrigeration circuit through the condenser and evaporator. Each compressor shall start in the unloaded position. Each compressor shall be provided with vibration isolators, crankcase heater, lubrication pump, thermal overloads, and high and low pressure safety cutoffs and protection against short cycling.

## 2.10 NOT USED

## 2.11 SYSTEM COMPONENTS

### 2.11.1 Refrigerant and Oil

Refrigerant shall be one of the fluorocarbon gases. Only Class III refrigerants will be accepted and shall have number designations and safety classifications in accordance with ASHRAE 34. Refrigerants shall meet the requirements of ARI 700 as a minimum. Refrigerants shall have an Ozone Depletion Potential (ODP) of less than or equal to 0.05. Contractor shall provide and install a complete charge of refrigerant for the installed system as recommended by the manufacturer. Except for factory sealed units, two complete charges of lubricating oil for each compressor crankcase shall be furnished. One charge shall be used during the system performance testing period. Following the satisfactory completion of the performance testing, the oil shall be drained and replaced with a second charge. Lubricating oil shall be of a type and grade recommended by the manufacturer for each compressor. Where color leak indicator dye is incorporated, charge shall be in accordance with manufacturer's recommendation.

### 2.11.2 Fans

Fan wheel shafts shall be supported by either maintenance-accessible lubricated antifriction block-type bearings, or permanently lubricated ball bearings. Unit fans shall be selected to produce the cfm required at the fan total pressure. Motor starters, if applicable, shall be magnetic across-the-line type with a totally enclosed enclosure. Thermal overload protection shall be of the manual or automatic-reset type. Fan wheels or propellers shall be constructed of aluminum or galvanized steel. Centrifugal fan wheel housings shall be of galvanized steel, and both centrifugal and propeller fan casings shall be constructed of aluminum or galvanized steel. Steel elements of fans, except fan shafts, shall be hot-dipped galvanized after fabrication or fabricated of mill galvanized steel. Mill-galvanized steel surfaces and edges damaged or cut during fabrication by forming, punching, drilling, welding, or cutting shall be recoated with an approved zinc-rich compound. Fan wheels or propellers shall be statically and dynamically balanced. Direct-drive fan motors shall be of the multiple-speed variety. Belt-driven fans shall have adjustable sheaves to provide not less than 120 percent fan-speed adjustment. The sheave size shall be selected so that the fan speed at the approximate midpoint of the sheave adjustment will produce the specified air quantity. Centrifugal scroll-type fans shall be provided with streamlined orifice inlet and V-belt drive. Each drive will be independent of any other drive. Propeller fans shall be direct-drive or V-belt drive type with fixed pitch blades. V-belt driven fans shall be mounted on a corrosion protected drive shaft supported by either maintenance-accessible lubricated antifriction block-type bearings, or permanently lubricated ball bearings. Each drive will be independent of any other drive. Drive bearings shall be protected with water slingers or shields. V-belt drives shall be fitted with guards where exposed to contact by personnel and fixed pitch sheaves.

### 2.11.3 NOT USED

### 2.11.4 NOT USED

#### 2.11.5 Coil Frost Protection

Each circuit shall be provided with a coil frost protection system which is a manufacturer's standard. The coil frost protection system shall use a temperature sensor in the suction line of the compressor to shut the compressor off when coil frosting occurs. Timers shall be used to prevent the compressor from rapid cycling.

#### 2.11.6 Pressure Vessels

Pressure vessels shall conform to ASME BPV VIII Div 1 or UL 207, as applicable for maximum and minimum pressure or temperature encountered. Where referenced publications do not apply, pressure components shall be tested at 1-1/2 times design working pressure. Refrigerant wetted carbon steel surfaces shall be pickled or abrasive blasted free of mill scale, cleaned, dried, charged, and sealed.

##### 2.11.6.1 NOT USED

##### 2.11.6.2 Liquid Receiver

A liquid receiver shall be provided when a system's condenser or compressor does not contain a refrigerant storage capacity of at least 20 percent in excess of a fully charged system. Receiver shall be designed, filled, and rated in accordance with the recommendations of ARI 495, except as modified herein. Receiver shall be fitted to include an inlet connection; an outlet drop pipe with oil seal and oil drain where necessary; two bull's-eye liquid level sight glass in same vertical plane, 90 degrees apart and perpendicular to axis of receiver or external gauge glass with metal guard and automatic stop valves; thermal well for thermostat; and purge, charge, equalizing, pressurizing, plugged drain and service valves on the inlet and outlet connections. Receiver shall be provided with a relief valve of capacity and setting in accordance with ASHRAE 15.

##### 2.11.6.3 NOT USED

##### 2.11.6.4 NOT USED

##### 2.11.7 NOT USED

##### 2.11.8 NOT USED

#### 2.11.9 Cabinet Construction

Casings for the specified unitary equipment shall be constructed of galvanized steel or aluminum sheet metal and galvanized or aluminum structural members. Minimum thickness of single wall exterior surfaces shall be 18 gauge galvanized steel or .071 inch thick aluminum on units with a capacity above 20 tons. Casing shall be fitted with lifting provisions, access panels or doors, fan vibration isolators, electrical control panel, corrosion-resistant components, and structural support members. Provisions to permit replacement of major unit components shall be incorporated. Penetrations of cabinet surfaces shall be sealed. Paint and finishes shall comply with the requirements specified in paragraph "Factory Coating".

##### 2.11.9.1 NOT USED

#### 2.11.9.2 Outdoor Cabinet

Outdoor cabinets shall be suitable for outdoor service with a weathertight, insulated and corrosion-protected structure. Cabinets constructed exclusively for indoor service which have been modified for outdoor service are not acceptable.

#### 2.11.10 NOT USED

#### 2.12 NOT USED

#### 2.13 NOT USED

#### 2.14 NOT USED

#### 2.15 NOT USED

#### 2.16 NOT USED

#### 2.17 REFRIGERANT LEAK DETECTOR

The Contractor shall equip the mechanical room, which contains the refrigeration equipment, with a refrigerant leak detector if the equipment provided utilizes R-123. The refrigerant leak detector shall be a Halogen-Specific detector to sense refrigerant within the mechanical room. The detector shall be specifically designed for area monitoring, and have an adjustable sensitivity such that it can detect refrigerant at or above 3 ppm, and initiate an alarm actuated at a value not greater than 10 ppm. The detector shall be located in the mechanical room where refrigerant from the equipment is likely to concentrate.

#### 2.18 OXYGEN SENSOR

The Contractor shall equip the mechanical room, which contains the refrigeration equipment, with an oxygen sensor if the equipment provided utilizes R-22 or R-134a. The oxygen sensor shall initiate an alarm if oxygen levels in the mechanical room drop below 19.5 volume percent. The sensor shall be specifically designed to measure the percent oxygen level within an area. The sensor shall have an adjustable sensitivity such that it will alarm when the oxygen level is 21 volume percent and below. The sensor shall be located in an area of the mechanical room containing the equipment where refrigerant from a leak is likely to concentrate.

#### 2.19 SIGNS

Metal signs shall be provided having letters not less than 0.5 inches in height designating the main shut-off valves to each refrigerant vessel, the electrical control of the refrigeration equipment, and the pressure limiting device.

#### 2.20 INSULATION

##### 2.20.1 Field Installed Insulation

Field installed insulation shall be as specified in Section C-15250 THERMAL INSULATION FOR MECHANICAL SYSTEM.

##### 2.20.2 Factory Installed Insulation

Factory applied insulation shall be as specified for the equipment to be insulated except that refrigerant suction lines shall be insulated with

unicellular plastic foam. Insulation shall comply with the fire hazard rating specified in Section C-15250 THERMAL INSULATION FOR MECHANICAL SYSTEM.

2.21 NOT USED

2.22 TEMPERATURE CONTROLS

Temperature controls shall be in accordance with Section C-15950 HEATING, VENTILATING AND AIR CONDITIONING HVAC CONTROL SYSTEMS.

2.23 NOT USED

2.24 NOT USED

2.25 REFRIGERANT PIPING

Refrigerant piping, valves, fittings, and accessories shall conform to the requirements of ASHRAE 15 and ASME B31.5, except as specified.

2.25.1 NOT USED

2.25.2 NOT USED

2.25.3 Steel Tubing

Steel tubing for refrigeration service shall be in accordance with ASTM A 334, Grade 1. Tubing with a nominal diameter of 3/8 inch or 1/2 inch shall have a wall thickness of 0.049 inches. Tubing with a nominal diameter of 3/4 inch through 2 inches shall have a wall thickness of 0.065 inches. Tubing with a nominal diameter of 2 1/2 inches through 4 inches shall have a wall thickness of 0.095 inches. Steel tubing shall be cold-rolled, electric-forged, welded-steel. One end of the tubing shall be provided with a socket. Steel tubing shall be cleaned, dehydrated, and capped.

2.25.4 Joints and Fittings, Steel Tubing

Joints and fittings shall be socket type provided by the steel tubing manufacturer.

2.25.5 Copper Tubing

Copper tubing shall conform to ASTM B 280 annealed or hard drawn as required. Copper tubing shall be soft annealed where bending is required and hard drawn where no bending is required. Soft annealed copper tubing shall not be used in sizes larger than 1-3/8 inches. Joints shall be brazed except that joints on lines 7/8 inch and smaller may be flared.

2.25.6 Joints and Fittings, Copper Tubing

Copper tube joints and fittings shall be flare joint type with short-shank flare, or solder-joint pressure type. Joints and fittings for brazed joint shall be wrought-copper or forged-brass sweat fittings. Cast sweat-type joints and fittings shall not be allowed for brazed joints.

2.25.7 Valves

Valves shall be pressure and temperature rated for contained refrigerant service and shall comply with ASME B31.5. Metals of construction shall be ferrous or copper based. Atmosphere exposed valve stems shall be stainless steel or

corrosion resistant metal plated carbon steel. Valve body connections shall be brazed or welded socket, flanged or combination thereof. Threaded connections shall not be used, except in pilot pressure or gauge lines where maintenance disassembly is required and welded flanges cannot be used. Valves shall be suitable for or fitted with extended copper ends for brazing in-place without disassembly. Ferrous body valves shall be fitted with factory fabricated and brazed copper transitions. To minimize system pressure drops, where practicable, globe valves shall be angle body type, and straight line valves shall be full port ball type. Control valve inlets shall be fitted with integral or adapted strainer or filter where recommended or required by manufacturer. Valves shall be cleaned and sealed moisture-tight.

#### 2.25.7.1 Refrigerant-Stop Valves

Valves, in sizes through 5/8 inch, shall be handwheel operated, straight or angle, packless diaphragm globe type with back-seating stem, brazed ends, except where SAE flare or retained seal cap connections are required. In sizes over 5/8 inch, valves shall be globe or angle type, wrench operated with ground-finish stems, or ball valves, packed especially for refrigerant service, back seated, and provided with seal caps. Refrigerant isolation and shut-off valves shall have retained or captive spindles and facilities for tightening or replacement of the gland packing under line pressure as applicable. Stop valves shall have back-seating plated steel stem, bolted bonnet in sizes 1-1/8 inches OD and larger, integral or flanged transition brazed socket. Valves in sizes through 2-1/2 inches shall be end-entry body assembly, full-port, floating ball type, with equalizing orifice fitted chrome plated ball, seats and seals of tetrafluoroethylene, chrome plated or stainless steel stem, and seal cap. In sizes 4 inch IPS and larger, and in smaller sizes where carbon steel piping is used, valve bodies shall be tongue and groove flanged and complete with mating flange, gaskets and bolting for socket or butt-weld connection. Purge, charge and receiver valves shall be of manufacturer's standard configuration.

#### 2.25.7.2 Check Valves

Valve shall be designed for service application, spring-loaded type where required, with resilient seat and with flanged body in sizes 1/2 inch and larger. Valve shall provide positive shut-off at 2 psi differential pressure.

#### 2.25.7.3 Liquid Solenoid Valves

Valves shall comply with ARI 760 and be suitable for continuous duty with applied voltages 15 percent under and 5 percent over nominal rated voltage at maximum and minimum encountered pressure and temperature service conditions. Valves shall be direct-acting or pilot-operating type, packless, except that packed stem, seal capped, manual lifting provisions shall be furnished. Solenoid coils shall be moisture-proof, UL approved, totally encapsulated or encapsulated and metal jacketed as required. Valves shall have safe working pressure of 400 psi and a maximum operating pressure differential of at least 200 psi at 85 percent rated voltage. Valves shall have an operating pressure differential suitable for the refrigerant used.

#### 2.25.7.4 Expansion Valves

Expansion valves conform to requirements of ARI 750. Valve shall be of the diaphragm and spring type with internal or external equalizers, and bulb and capillary tubing. Valve shall be provided with an external superheat adjustment along with a seal cap. Internal equalizers may be utilized where flowing refrigerant pressure drop between outlet of the valve and inlet to the evaporator coil is negligible and pressure drop across the evaporator is less than the

pressure difference corresponding to 2 degrees F of saturated suction temperature at evaporator conditions. Bulb charge shall be determined by the manufacturer for the application and such that liquid will remain in the bulb at all operating conditions. Gas limited liquid charged valves and other valve devices for limiting evaporator pressure shall not be used without a distributor or discharge tube or effective means to prevent loss of control when bulb becomes warmer than valve body. Pilot-operated valves shall have a characterized plug to provide required modulating control. A de-energized solenoid valve may be used in the pilot line to close the main valve in lieu of a solenoid valve in the main liquid line. An isolatable pressure gauge shall be provided in the pilot line, at the main valve. Automatic pressure reducing or constant pressure regulating expansion valves may be used only where indicated or for constant evaporator loads.

#### 2.25.7.5 Safety Relief Valve

Valve shall be the two-way type. Single type valves shall be used only where indicated. Valve shall bear the ASME code symbol. Valve capacity shall be certified by the National Board of Boiler and Pressure Vessel Inspectors. Valve shall be of an automatically reseating design after activation.

#### 2.25.7.6 Evaporator Pressure Regulators, Direct-Acting

Valve shall include a diaphragm/spring power assembly, external pressure adjustment with seal cap, and pressure gauge port. Valve shall maintain a constant inlet pressure by balancing inlet pressure on diaphragm against an adjustable spring load. Pressure drop at system design load shall not exceed the pressure difference corresponding to a 2 degrees F change in saturated refrigerant temperature at evaporator operating suction temperature. Spring shall be selected for indicated maximum allowable suction pressure range.

#### 2.25.7.7 Refrigerant Access Valves

Refrigerant access valves and hose connections shall be in accordance with ARI 720.

#### 2.25.8 Accessories

##### 2.25.8.1 Filter Driers

Driers shall conform to ARI 710. Sizes 5/8 inch and larger shall be the full flow, replaceable core type. Sizes 1/2 inch and smaller shall be the sealed type. Cores shall be of suitable desiccant that will not plug, cake, dust, channel, or break down, and shall remove water, acid, and foreign material from the refrigerant. Filter driers shall be constructed so that none of the desiccant will pass into the refrigerant lines. Minimum bursting pressure shall be 1,500 psi.

##### 2.25.8.2 Sight Glass and Liquid Level Indicator

a. Assembly and Components: Assembly shall be pressure- and temperature-rated and constructed of materials suitable for the service. Glass shall be borosilicate type. Ferrous components subject to condensation shall be electro-galvanized.

b. Gauge Glass: Gauge glass shall include top and bottom isolation valves fitted with automatic checks, and packing followers; red-line or green-line gauge glass; elastomer or polymer packing to suit the service; and gauge glass guard.

c. Bull's-Eye and Inline Sight Glass Reflex Lens: Bull's-eye and inline sight glass reflex lens shall be provided for dead-end liquid service. For pipe



line mounting, two plain lenses in one body suitable for backlighted viewing shall be provided.

d. Moisture Indicator: Indicator shall be a self-reversible action, moisture reactive, color changing media. Indicator shall be furnished with full-color-printing tag containing color, moisture and temperature criteria. Unless otherwise indicated, the moisture indicator shall be an integral part of each corresponding sight glass.

2.25.8.3 NOT USED

2.25.8.4 NOT USED

2.25.8.5 Strainers

Strainers used in refrigerant service shall have brass or cast iron body, Y-or angle-pattern, cleanable, not less than 60-mesh noncorroding screen of an area to provide net free area not less than ten times the pipe diameter with pressure rating compatible with the refrigerant service. Screens shall be stainless steel or monel and reinforced spring-loaded where necessary for bypass-proof construction.

2.25.8.6 Brazing Materials

Brazing materials for refrigerant piping shall be in accordance with FS QQ-B-654, Classification BCuP-5.

2.26 NOT USED

2.27 FABRICATION

2.27.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish, except that items located outside of buildings shall have weather resistant finishes that will withstand 125 hours exposure to the salt spray test specified in ASTM B 117 using a 25 percent sodium chloride solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D 520, Type I.

2.27.2 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section C-09900 PAINTING, GENERAL.

2.27.2.1 Color Coding

Color coding for piping identification is specified in Section C-09900 PAINTING, GENERAL.

2.27.2.2 NOT USED

## PART 3 EXECUTION

### 3.1 INSTALLATION

Work shall be performed in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements. Where equipment is specified to conform to the requirements of ASME BPV VIII Div 1 and ASME BPV IX, the design, fabrication, and installation of the system shall conform to ASME BPV VIII Div 1 and ASME BPV IX.

#### 3.1.1 Equipment

Refrigeration equipment and the installation thereof shall conform to ASHRAE 15. Necessary supports shall be provided for all equipment, appurtenances, and pipe as required, including frames or supports for condensing units and similar items. Compressors shall be isolated from the building structure. If mechanical vibration isolators are not provided, vibration absorbing foundations shall be provided. Each foundation shall include isolation units consisting of machine and floor or foundation fastenings, together with intermediate isolation material. Other floor-mounted equipment shall be set on not less than a 6 inch concrete pad doweled in place. Foundation drawings, bolt-setting information, and foundation bolts shall be furnished prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Concrete for foundations shall be as specified in Section C-03300 CONCRETE FOR BUILDING CONSTRUCTION. Equipment shall be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions.

#### 3.1.2 Mechanical Room Ventilation

Mechanical rooms containing refrigeration components or equipment shall be ventilated to the outdoors as indicated. Refrigerant relief device vent piping which is not returned to the system shall be routed to the atmosphere as indicated. Relief piping shall be supported independently of relief device and braced against reaction forces. The ventilation system shall be in accordance with Section C-15895 AIR SUPPLY, DISTRIBUTION, VENTILATION AND EXHAUST SYSTEM.

#### 3.1.3 Building Surface Penetrations

Sleeves in nonload bearing surfaces shall be galvanized sheet metal, conforming to ASTM A 525, Coating Class G-90, 20 gauge. Sleeves in load bearing surfaces shall be uncoated carbon steel pipe, conforming to ASTM A 53, Schedule 20. Sealants shall be applied to moisture and oil-free surfaces and elastomers to not less than 1/2 inch depth. Sleeves shall not be installed in structural members.

##### 3.1.3.1 NOT USED

##### 3.1.3.2 General Service Areas

Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall be of such size as to provide a minimum of 1/4 inch all-around clearance between bare pipe and sleeves or between jacketed-insulation and sleeves. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over-insulation and sleeve shall be sealed in accordance with Section C-07920 JOINT SEALING.

##### 3.1.3.3 NOT USED

#### 3.1.3.4 Fire-Rated Penetrations

Penetration of fire-rated walls, partitions, and floors shall be sealed as specified in Section C-07270 FIRESTOPPING.

#### 3.1.3.5 NOT USED

#### 3.1.4 NOT USED

#### 3.1.5 General Piping Installation

##### 3.1.5.1 Brazed Joints

Brazing shall be performed in accordance with AWS-01, except as modified herein. During brazing, the pipe and fittings shall be filled with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Brazing flux shall not be used. Surplus brazing material shall be removed at all joints. Steel tubing joints shall be made in accordance with the manufacturer's recommendations. Joints in steel tubing shall be painted with the same material as the baked-on coating within 8 hours after joints are made. Tubing shall be protected against oxidation during brazing by continuous purging of the inside of the piping using nitrogen. Piping shall be supported prior to brazing and not be sprung or forced.

##### 3.1.5.2 Threaded Joints

Threaded joints shall be made with tapered threads and made tight with PTFE tape complying with ASTM D 3308 or equivalent thread-joint compound applied to the male threads only. Not more than three threads shall show after the joint is made.

##### 3.1.5.3 NOT USED

##### 3.1.5.4 NOT USED

##### 3.1.5.5 Flared Connections

When flared connections are used, a suitable lubricant shall be used between the back of the flare and the nut in order to avoid tearing the flare while tightening the nut.

#### 3.1.6 NOT USED

#### 3.1.7 Refrigeration Piping

Unless otherwise specified, pipe and fittings installation shall conform to requirements of ASME B31.5. Pipe shall be cut accurately to measurement established at the jobsite and worked into place without springing or forcing. Cutting or otherwise weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipes shall be cut square, shall have burrs removed by reaming, and shall be installed in a manner to permit free expansion and contraction without damage to joints or hangers. Filings, dust, or dirt shall be wiped from interior of pipe before connections are made.

#### 3.1.7.1 Directional Changes

Changes in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide-sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, or other malformations will not be accepted.

#### 3.1.7.2 Functional Requirements

Piping shall be installed 1/2 inch per 10 feet of pipe in the direction of flow to ensure adequate oil drainage. Open ends of refrigerant lines or equipment shall be properly capped or plugged during installation to keep moisture, dirt, or other foreign material out of the system. Piping shall remain capped until installation. Equipment piping shall be in accordance with the equipment manufacturer's recommendations and the contract drawings.

#### 3.1.7.3 Manual Valves

Stop valves shall be installed on each side of each piece of equipment such as compressors, condensers, evaporators, receivers, and other similar items in multiple-unit installation, to provide partial system isolation as required for maintenance or repair. Angle and globe valves shall be installed with stems horizontal unless otherwise indicated. Ball valves shall be installed with stems positioned to facilitate operation and maintenance. Isolating valves for pressure gauges and switches shall be external to thermal insulation. Safety switches shall not be fitted with isolation valves. Thermal wells for insertion thermometers and thermostats shall extend beyond thermal insulation surface not less than 1 inch. Filter dryers having access ports may be considered a point of isolation. Purge valves shall be provided at all points of systems where accumulated noncondensable gases would prevent proper system operation. Valves shall be furnished to match line size, unless otherwise indicated or approved.

#### 3.1.7.4 Expansion Valves

Expansion valves shall be installed with the thermostatic expansion valve bulb located on top of the suction line when the suction line is less than 2-1/8 inches in diameter and at the 4 o'clock or 8 o'clock position on lines larger than 2-1/8 inches. The bulb shall be securely fastened with two clamps. The bulb shall be insulated. The bulb shall be installed in a horizontal portion of the suction line, if possible, with the pigtail on the bottom. If the bulb must be installed in a vertical line, the bulb tubing shall be facing up.

#### 3.1.7.5 Valve Identification

Each system valve, including those which are part of a factory assembly, shall be tagged. Tags shall be in alphanumeric sequence, progressing in direction of fluid flow. Tags shall be embossed, engraved, or stamped plastic or nonferrous metal of various shapes, sized approximately 1-3/8 inch diameter, or equivalent dimension, substantially attached to a component or immediately adjacent thereto. Tags shall be attached with nonferrous, heavy duty, bead or link chain, 14 gauge annealed wire, nylon cable bands or as approved. Tag numbers shall be referenced in Operation and Maintenance Manuals and system diagrams.

#### 3.1.7.6 Vibration Dampers

Vibration damper shall be provided in the suction and discharge lines on spring mounted compressors. Vibration dampers shall be installed parallel with the

shaft of the compressor and be anchored firmly at the upstream end on the suction line and the downstream end in the discharge line.

#### 3.1.7.7 Strainers

Strainers shall be provided immediately ahead of solenoid valves and expansion devices and where indicated. Strainers may be an integral part of the expansion valve.

#### 3.1.7.8 Filter Dryer

A liquid line filter dryer shall be provided on each refrigerant circuit located such that all liquid refrigerant passes through a filter dryer. Dryers shall be sized in accordance with the manufacturers recommendations. A dryer shall be installed such that it can be isolated from the system, the isolated portion of the system evacuated, and the filter dryer replaced. Dryers shall be installed in the horizontal position except replaceable core filter dryers may be installed in the vertical position with the access flange on the bottom.

#### 3.1.7.9 Sight Glass

A moisture indicating sight glass shall be installed in all refrigerant circuits down stream of filter dryers and where indicated. Sight glass shall be full line size.

#### 3.1.7.10 Flexible Connectors

Flexible metallic connectors shall be installed perpendicular to line of motion being isolated. Piping for equipment with bidirectional motion shall be fitted with two flexible connectors, in perpendicular planes. Reinforced elastomer flexible connectors shall be installed in accordance with manufacturer's instructions. Piping guides and restraints related to flexible connectors shall be provided as required.

#### 3.1.8 Thermometers

Thermometers located within 5 feet of floor may be rigid stem type. Where thermal well is located above 5 feet above floor, thermometer shall be universal adjustable angle type or remote element type to 7 feet above floor and remote element type where thermal well is 7 feet or more above floor. Thermometers shall be located in refrigerant liquid line leaving receiver, refrigerant suction line at each evaporator or liquid cooler, and where indicated or required for proper operation of equipment.

#### 3.1.9 Piping Supports

Refrigerant pipe supports shall be in accordance with ASME B31.5. Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement, when operating temperatures exceed ambient temperatures, shall be supported by variable spring hangers and supports or by constant support hangers.

##### 3.1.9.1 Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads as specified under Section C-13080 SEISMIC PROTECTION FOR MECHANICAL, ELECTRICAL

EQUIPMENT. Structural steel required for reinforcement to properly support piping, headers, and equipment but not shown shall be provided under this section. Material used for support shall be as specified under Section C-05210 STRUCTURAL STEEL.

### 3.1.9.2 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Masonry anchors for overhead applications shall be constructed of ferrous materials only. Material used for support shall be as specified under Section C-05210 STRUCTURAL STEEL.

### 3.1.10 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein. Pipe hanger types 5, 12, and 26 shall not be used.

#### 3.1.10.1 Hangers

Type 3 shall not be used on insulated piping. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

#### 3.1.10.2 Inserts

Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustments may be used if they otherwise meet the requirements for Type 18 inserts.

#### 3.1.10.3 C-Clamps

Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

#### 3.1.10.4 Angle Attachments

Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

#### 3.1.10.5 Saddles and Shields

Where Type 39 saddle or Type 40 shield are permitted for a particular pipe attachment application, the Type 39 saddle, connected to the pipe, shall be used on all pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 40 shields shall be used on all piping less than 4 inches and all piping 4 inches and larger carrying medium less than 60 degrees F. A high density insulation insert of cellular glass shall be used under the Type 40 shield for piping 2 inches and larger.

#### 3.1.10.6 Horizontal Pipe Supports

Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves.

#### 3.1.10.7 Vertical Pipe Supports

Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers, and at vent terminations.

#### 3.1.10.8 Pipe Guides

Type 35 guides using, steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

#### 3.1.10.9 Steel Slides

Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inches and larger, a Type 39 saddle shall be used. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.

#### 3.1.10.10 NOT USED

#### 3.1.10.11 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run.

#### 3.1.11 NOT USED

#### 3.1.12 NOT USED

#### 3.1.13 Piping Identification

Each piping system and direction of fluid flow shall be identified in accordance with applicable provisions of ANSI A13.1 with color coded, water, moisture and broad-spectrum temperature resistant, plastic labels.

#### 3.1.14 NOT USED

#### 3.1.15 NOT USED

#### 3.1.16 NOT USED

#### 3.1.17 Field Applied Insulation

Field applied insulation shall be as specified in Section C-15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

#### 3.1.18 Factory Applied Insulation

Refrigerant suction lines between an evaporator and compressors and any cold gas inlet connections to gas cooled motors shall be insulated with not less than 3/4 inch thick unicellular plastic foam.

### 3.1.19 Framed Instructions

Framed instructions shall be framed under glass or laminated plastic and be posted where directed. Instructions shall include equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The instructions shall be posted before acceptance testing of the system.

## 3.2 TESTS

Tests shall be conducted in the presence of the Contracting Officer. Utilities for testing shall be provided as specified in the "SPECIAL CONTRACT REQUIREMENTS". Water and electricity required for the tests will be furnished by the Government. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor. The services of a qualified technician shall be provided as required to perform all tests and procedures indicated herein. Field tests shall be coordinated with Section C-15990 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

### 3.2.1 NOT USED

### 3.2.2 Refrigerant System

After all components of the refrigerant system have been installed and connected, the entire refrigeration system shall be subjected to a pneumatic test as described herein.

#### 3.2.2.1 Preliminary Procedures

Prior to pneumatic testing, equipment which has been factory tested and refrigerant charged as well as equipment which could be damaged or cause personnel injury by imposed test pressure, positive or negative, shall be isolated from the test pressure or removed from the system. Safety relief valves and rupture discs, where not part of factory sealed systems, shall be removed and openings capped or plugged.

#### 3.2.2.2 Pneumatic Test

Pressure control and excess pressure protection shall be provided at the source of test pressure. Valves shall be wide open, except those leading to the atmosphere. Test gas shall be dry nitrogen, with minus 70 degree F dewpoint and less than 5 ppm oil. Test pressure shall be applied in two stages before any refrigerant pipe is insulated or covered. First stage test shall be at 10 psi with every joint being tested with a thick soap or color indicating solution. Second stage tests shall raise the system to the minimum refrigerant leakage test pressure specified in ASHRAE 15 with a maximum test pressure 25 percent greater. Pressure above 100 psig shall be raised in 10 percent increments with a pressure acclimatizing period between increments. The initial test pressure shall be recorded along with the ambient temperature to which the system is exposed. Final test pressures of the second stage shall be maintained on the system for a minimum of 24 hours. At the end of the 24 hour period, the system pressure will be recorded along with the ambient temperature to which the system is exposed. A correction factor of 0.3 psi will be allowed for each degree F change between test space initial and final ambient temperature, plus for increase and minus for a decrease. If the corrected system pressure is not exactly equal to the initial system test pressure, then the system shall be investigated for leaking joints. To repair leaks, the joint shall be taken apart, thoroughly



cleaned, and reconstructed as a new joint. Joints repaired by caulking, remelting, or back-welding\brazing shall not be acceptable. Following repair, the entire system shall be retested using the pneumatic tests described above. The entire system shall be reassembled once the pneumatic tests are satisfactorily completed.

#### 3.2.2.3 Evacuation Test

Following satisfactory completion of the pneumatic tests, the pressure shall be relieved and the entire system shall be evacuated to an absolute pressure of 300 micrometers. During evacuation of the system, the ambient temperature shall be higher than 35 degrees F. No more than one system shall be evacuated at one time by one vacuum pump. Once the desired vacuum has been reached, the vacuum line shall be closed and the system shall stand for 1 hour. If the pressure rises over 500 micrometers after the 1 hour period, then the system shall be evacuated again down to 300 micrometers and let set for another 1 hour period. The system shall not be charged until a vacuum of at least 500 micrometers is maintained for a period of 1 hour without the assistance of a vacuum line. If during the testing the pressure continues to rise, check the system for leaks, repair as required, and repeat the evacuation procedure. During evacuation, pressures shall be recorded by a thermocouple-type, electronic-type, or a calibrated-micrometer type gauge.

#### 3.2.2.4 System Charging and Startup Test

Following satisfactory completion of the evacuation tests, the system shall be charged with the required amount of refrigerant by raising pressure to normal operating pressure and in accordance with manufacturer's procedures. Following charging, the system shall operate with high-side and low-side pressures and corresponding refrigerant temperatures, at design or improved values. The entire system shall be tested for leaks. Fluorocarbon systems shall be tested with halide torch or electronic leak detectors.

#### 3.2.2.5 Refrigerant Leakage

If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system shall immediately be isolated from the remainder of the system and the refrigerant pumped into the system receiver or other suitable container. Under no circumstances shall the refrigerant be discharged into the atmosphere.

#### 3.2.2.6 Contractor's Responsibility

The Contractor shall, at all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps shall include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time shall more than 3 ounces of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year shall be repaired in accordance with the requirements herein at no cost to the Government including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

#### 3.2.3 NOT USED

#### 3.2.4 NOT USED

#### 3.2.5 NOT USED

### 3.2.6 System Performance Tests

After the foregoing tests have been completed and before each refrigeration system is accepted, tests to demonstrate the general operating characteristics of all equipment shall be conducted by a registered professional engineer or an approved manufacturer's start-up representative experienced in system start-up and testing, at such times as directed. Tests shall cover a period of not less than 48 hours for each system and demonstrate that the entire system is functioning in accordance with the drawings and specifications. Corrections and adjustments shall be made as necessary and tests shall be re-conducted to demonstrate that the entire system is functioning as specified. Prior to acceptance, service valve seal caps and blanks over gauge points shall be installed and tightened. Any refrigerant lost during the system startup shall be replaced. If tests do not demonstrate satisfactory system performance, deficiencies shall be corrected and the system shall be retested.

### 3.3 NOT USED

### 3.4 CLEANING AND ADJUSTING

#### 3.4.1 Piping

Prior to testing, pipes shall be cleaned free of scale and all foreign matter. Strainers and valves shall be thoroughly cleaned.

#### 3.4.2 NOT USED

#### 3.4.3 Equipment

Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. System shall be maintained in this clean condition until final acceptance. Bearings shall be lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed.

#### 3.4.4 Testing, Adjusting, and Balancing

Testing, adjusting, and balancing shall be as specified in Section C-15990 TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS.

### 3.5 DEMONSTRATIONS

Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total 4 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the operation and maintenance manuals as well as demonstrations of routine maintenance operations.

-- End of Section --

SECTION C-15895

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 410	(1991) Forced-Circulation Air-Cooling and Air-Heating Coils
ARI 430	(1989) Central-Station Air-Handling Units
ARI 880	(1990) Air Terminals
ARI Guideline D	(1987) Application and Installation of Central Station Air-Handling Units

AIR CONDITIONING CONTRACTORS OF AMERICA (ACCA)

ACCA Manual 4	(1990) Installation Techniques for Perimeter Heating and Cooling
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AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 210	(1985) Laboratory Methods of Testing Fans for Rating
AMCA 300	(1996) Reverberant Room Method for Sound Testing of Fans

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABEMA)

ABEMA 9	(1990) Load Ratings and Fatigue Life for Ball Bearings
ABEMA 11	(1990) Load Ratings and Fatigue Life for Roller Bearings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1993a) Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
ASTM C 107	(1989) Panel Spalling Testing High-Duty Fireclay Brick
ASTM C 916	(1985; R 1990) Adhesives for Duct Thermal Insulation

ASTM E 84 (1994) Surface Burning Characteristics of Building Materials

ASTM E 437 (1992) Industrial Wire Cloth and Screens (Square Opening Series)

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 52.1 (1992) Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter

ASHRAE 68 (1986) Laboratory Method of Testing In-Duct Sound Power Measurement Procedures for Fans

ASHRAE 70 (1991) Method of Testing Rating the Performance of Air Outlets and Inlets

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME BPV VIII Div 1 (1992; Addenda Dec 1992) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (1993; Rev 1; Rev 2) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

NFPA 90A (1993) Installation of Air Conditioning and Ventilating Systems

NORTH AMERICAN INSULATION MANUFACTURERS ASSOCIATION (NAIMA)

NAIMA-01 (1993) TIMA Fibrous Glass Duct Construction Standards

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA-05 (1992) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems

SMACNA-06 (1995) HVAC Duct Construction Standards - Metal and Flexible

UNDERWRITERS LABORATORIES (UL)

UL-01 (1996; Supple) Building Materials Directory

UL-03 (1996; Supple) Electrical Construction Materials Directory

UL-05 (1996; Supple) Fire Resistance Directory

UL 181 (1996; Rev Oct 1996) Factory-Made Air Ducts and Connectors

UL 214 (1993) Tests for Flame-Propagation of Fabrics and Films

UL 555 (1995) Fire Dampers

UL 723 (1993; Rev Apr 1994) Test for Surface Burning Characteristics of Building Materials

UL 900 (1994) Test Performance of Air Filter Units

#### 1.2 COORDINATION OF TRADES

Ductwork, piping offsets, fittings, and accessories shall be furnished as required to provide a complete installation and to eliminate interference with other construction.

#### 1.3 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-01 Data

Components and Equipment Data; GA.

Manufacturer's catalog data shall be included with the detail drawings for the following items. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with contract requirements for the following:

- a. Ductwork Components
- b. Air Systems Equipment
- c. Air Handling Units
- d. Terminal Units

##### SD-04 Drawings

Air Supply, Distribution, Ventilation, and Exhaust Equipment; GA.

Drawings shall consist of equipment layout including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications; and piping layout showing the location of all guides and anchors, the load imposed on each support or anchor, and typical support details. Drawings shall include any information required to demonstrate that the system has been coordinated and will properly function as a unit and shall show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

#### SD-06 Instructions

Test Procedures; FIO.

Proposed test procedures for piping hydrostatic test, ductwork leak test, and performance tests of systems, at least 2 weeks prior to the start of related testing.

System Diagrams; GA.

Proposed diagrams, at least 2 weeks prior to start of related testing. System diagrams that show the layout of equipment, piping, and ductwork, and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system shall be framed under glass or laminated plastic. After approval, these items shall be posted where directed.

#### SD-07 Schedules

Test Schedules; GA.

Proposed test schedules for hydrostatic test of piping, ductwork leak test, and performance tests, at least 2 weeks prior to the start of related testing.

Field Training Schedule; GA.

Proposed schedule for field training, at least 2 weeks prior to the start of related training.

#### SD-08 Statements

Similar Services; FIO.

Statement demonstrating successful completion of similar services on at least 5 projects of similar size and scope, at least 2 weeks prior to submittal of other items required by this section.

#### SD-09 Reports

Test Reports; FIO.

Test reports for the piping hydrostatic test, ductwork leak test, and performance tests in booklet form, upon completion of testing. Reports shall document phases of tests performed including initial test summary, repairs/adjustments made, and final test results.

#### SD-13 Certificates

Bolts; FIO.

Written certification from the bolt manufacturer that the bolts furnished comply with the requirements of this specification. The certification shall include illustrations of product markings, and the number of each type of bolt to be furnished.

#### SD-19 Operation and Maintenance Manuals

Air Supply, Distribution, Ventilation, and Exhaust Manuals; GA.

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 2 weeks prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

Components and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years before bid opening. The 2-year experience shall include applications of components and equipment under similar circumstances and of similar size. The 2 years must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization.

### 2.2 ASBESTOS PROHIBITION

Asbestos and asbestos-containing products shall not be used.

### 2.3 NAMEPLATES

Equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

### 2.4 EQUIPMENT GUARDS AND ACCESS

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded according to OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

### 2.5 PIPING COMPONENTS

### 2.5.1 Water Heating System

Water heating system pipe, valves and other system components and accessories shall be as specified in Section C-15569 WATER HEATING; GAS; UP TO 20 MBTUH.

### 2.5.2 Refrigeration System

Refrigeration system pipe, valves and other system components and accessories shall be as specified in Section C-15653 REFRIGERANT SYSTEM (UNITARY TYPE).

### 2.5.3 Insulation

Shop and field applied pipe insulation shall be as specified in Section C-15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

### 2.5.4 Condensate Drain Lines

Condensate drainage shall be provided for each item of equipment that generates condensate as specified for drain, waste, and vent piping systems in Section C-15400 PLUMBING, GENERAL PURPOSE.

## 2.6 ELECTRICAL WORK

Electrical motor-driven equipment specified shall be provided complete with motor, and drives. Unless otherwise specified, electric equipment, including wiring and motor efficiencies, shall be according to Section C-16415 ELECTRICAL WORK, INTERIOR. Electrical characteristics and enclosure type shall be as shown. Unless otherwise indicated, motors of 1 hp and above shall be high efficiency type. Motor starters shall be provided as indicated. Each motor shall be according to NEMA MG 1 and shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices, but not shown, shall be provided.

## 2.7 CONTROLS

Controls shall be provided as specified in Section C-15950 HEATING, VENTILATING AND AIR CONDITIONING (HVAC) CONTROL SYSTEMS.

## 2.8 DUCTWORK COMPONENTS

### 2.8.1 Metal Ductwork

All aspects of metal ductwork construction, including all fittings and components, shall comply with SMACNA-06 unless otherwise specified. Elbows shall be radius type with a centerline radius of 1-1/2 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes may be used. Static pressure Class 1/2, 1, and 2 inch w.g. ductwork shall meet the requirements of Seal Class C. Class 3 through 10 inch shall meet the requirements of Seal Class A. Sealants shall conform to fire hazard classification specified in Section C-15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Pressure sensitive tape shall not be used as a sealant. Spiral lock seam duct, and flat oval shall be made with duct sealant and locked with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA-06. The sealant shall be applied to the exposed male part of the fitting collar so that the sealer will be on the inside of the joint and fully protected by the metal of the duct fitting. One brush coat of the sealant shall be applied over the outside of the joint to at least 2 inch band width



covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar will not be acceptable. Outdoor air intake ducts and plenums shall be fabricated with watertight soldered or brazed joints and seams.

#### 2.8.1.1 Transitions

Diverging air flow transitions shall be made with each side pitched out a maximum of 15 degrees, for an included angle of 30 degrees. Transitions for converging air flow shall be made with each side pitched in a maximum of 30 degrees, for an included angle of 60 degrees, or shall be as indicated. Factory-fabricated reducing fittings for systems using round duct sections when formed to the shape of the ASME short flow nozzle, need not comply with the maximum angles specified.

#### 2.8.1.2 Metallic Flexible Duct

Metallic type duct shall be single-ply galvanized steel or two-ply aluminum, self supporting to 8-foot spans. Duct shall be of corrugated/interlocked, folded and knurled type seam construction, bendable without damage through 180 degrees with a throat radius equal to 1/2 duct diameter. Duct shall conform to UL 181 and shall be rated for positive or negative working pressure of 15 inches water gauge at 350 degrees F when duct is aluminum, and 650 degrees F when duct is galvanized steel.

#### 2.8.1.3 Insulated Nonmetallic Flexible Duct Runouts

Flexible duct runouts shall be used only where indicated. Runout length shall be as shown on the drawings, but shall in no case exceed 10 feet. Runouts shall be preinsulated, factory fabricated, and shall comply with NFPA 90A and UL 181. Either field or factory applied vapor barrier shall be provided. Where coil induction or high velocity units are supplied with vertical air inlets, a streamlined and vaned and mitered elbow transition piece shall be provided for connection to the flexible duct or hose. The last elbow to these units, other than the vertical air inlet type, shall be a die-stamped elbow and not a flexible connector. Insulated flexible connectors may be used as runouts. The insulated material and vapor barrier shall conform to the requirements of Section C-15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS. The insulation material surface shall not be exposed to the air stream.

#### 2.8.1.4 General Service Duct Connectors

A flexible duct connector approximately 6 inches in width shall be provided where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, the flexible material shall be secured by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, the flexible material locked to metal collars shall be installed using normal duct construction methods. The composite connector system shall comply with UL 214 and be classified as "flame-retarded fabrics" in UL-01.

#### 2.8.1.5 NOT USED

#### 2.8.2 Fibrous Glass Ductwork

Fibrous glass ductwork may be provided in lieu of sheet metal ductwork except that fibrous glass ductwork will not be allowed in fan and equipment rooms, where subject to traffic or weather damage, for outside air intakes, for risers of more than two stories, to convey solids or corrosive gases, in concrete, for burial below grade, as casings or housings, or in systems used for life support systems. Fibrous glass ductwork, including all components, shall be fabricated according to NAIMA-01 where the velocity and the static pressure are within its scope. Where the velocity or static pressure exceeds these limits, the ductwork

manufacturer shall certify that the ductwork is intended for the velocities and pressures to be encountered, and that the proposed installation meets all performance criteria specified herein for metal ductwork. Fibrous glass ductwork shall have the thermal equivalent of the insulation specified for metal ductwork in Section C-15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Field or factory fabricated fibrous glass ductwork shall conform to UL 181, Class 1. Duct wall penetrations, transverse joints and longitudinal seams shall be sealed as instructed by the manufacturer by one of the methods prescribed by NAIMA-01, where applicable, except that pressure sensitive tape shall not be used as a sealant. All items necessary for a complete installation shall be provided as specified for sheet metal duct systems.

### 2.8.3 Ductwork Accessories

#### 2.8.3.1 Duct Access Doors

Access doors shall be provided in ductwork where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system, and unless otherwise shown, shall conform to SMACNA-06. Access doors shall be provided upstream and downstream of air flow measuring primaries and heating and cooling coils. Doors shall be minimum 15 by 18 inches, unless otherwise shown. Where duct size will not accommodate this size door, the doors shall be made as large as practicable. Doors 24 by 24 inches or larger shall be provided with fasteners operable from both sides. Doors in insulated ducts shall be the insulated type.

#### 2.8.3.2 Fire Dampers

Fire dampers shall be 1-1/2 hour fire rated unless otherwise indicated. Fire dampers shall conform to the requirements of NFPA 90A and UL 555. Fire dampers shall be automatic operating type and shall have a dynamic rating suitable for the maximum air velocity and pressure differential to which it will be subjected. Fire dampers shall be approved for the specific application, and shall be installed according to their listing. Fire dampers shall be equipped with a steel sleeve or adequately sized frame installed in such a manner that disruption of the attached ductwork, if any, will not impair the operation of the damper. Sleeves or frames shall be equipped with perimeter mounting angles attached on both sides of the wall or floor opening. Ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce the ceiling of the assemblies shall be constructed in conformance with UL-05. Fire dampers shall be curtain type with damper blades out of the air stream. Dampers shall not reduce the duct or the air transfer opening cross-sectional area. Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness. Unless otherwise indicated, the installation details given in SMACNA-05 and in manufacturer's instructions for fire dampers shall be followed.

#### 2.8.3.3 Splitters and Manual Balancing Dampers

Splitters and manual balancing dampers shall be furnished with accessible operating mechanisms. Where operators occur in finished portions of the building, operators shall be chromium plated with all exposed edges rounded. Splitters shall be operated by quadrant operators or 3/16 inch rod brought through the side of the duct with locking setscrew and bushing. Two rods are required on splitters over 8 inches. Manual volume control dampers shall be operated by locking-type quadrant operators. Dampers and splitters shall be 2 gauges heavier than the duct in which installed. Unless otherwise indicated, multileaf dampers shall be opposed blade type with maximum blade width of 12 inches. Access doors or panels shall be provided for all concealed damper operators and locking setscrews. Unless otherwise indicated, the locking-type

quadrant operators for dampers, when installed on ducts to be thermally insulated, shall be provided with stand-off mounting brackets, bases, or adapters to provide clearance between the duct surface and the operator not less than the thickness of the insulation. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer. Volume dampers shall be provided where indicated.

#### 2.8.3.4 Air Deflectors and Branch Connections

Air deflectors shall be provided at duct mounted supply outlets, at takeoff or extension collars to supply outlets, at duct branch takeoff connections, and at 90 degree elbows, as well as at locations as indicated on the drawings or otherwise specified. Conical branch connections or 45 degree entry connections may be used in lieu of deflectors or extractors for branch connections. All air deflectors, except those installed in 90 degree elbows, shall be provided with an approved means of adjustment. Adjustment shall be made from easily accessible means inside the duct or from an adjustment with sturdy lock on the face of the duct. When installed on ducts to be thermally insulated, external adjustments shall be provided with stand-off mounting brackets, integral with the adjustment device, to provide clearance between the duct surface and the adjustment device not less than the thickness of the thermal insulation. Air deflectors shall be factory-fabricated units consisting of curved turning vanes or louver blades designed to provide uniform air distribution and change of direction with minimum turbulence or pressure loss. Air deflectors shall be factory or field assembled. Blade air deflectors, also called blade air extractors, shall be approved factory fabricated units consisting of equalizing grid and adjustable blade and lock. Adjustment shall be easily made from the face of the diffuser or by position adjustment and lock external to the duct. Stand-off brackets shall be provided on insulated ducts and are described herein. Fixed air deflectors, also called turning vanes, shall be provided in 90 degree elbows.

#### 2.8.4 Duct Sleeves, Framed Prepared Openings, Closure Collars

##### 2.8.4.1 Duct Sleeves

Duct sleeves shall be provided for round ducts 15 inches in diameter or less passing through floors, walls, ceilings, or roof, and installed during construction of the floor, wall, ceiling, or roof. Round ducts larger than 15 inches in diameter and square, rectangular, and oval ducts passing through floors, walls, ceilings, or roof shall be installed through framed prepared openings. The Contractor shall be responsible for the proper size and location of sleeves and prepared openings. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Framed prepared openings shall be fabricated from 20 gauge galvanized steel, unless otherwise indicated. Where sleeves are installed in bearing walls or partitions, black steel pipe, ASTM A 53, Schedule 20 shall be used. Sleeve shall provide 1 inch clearance between the duct and the sleeve or 1 inch clearance between the insulation and the sleeve for insulated ducts.

##### 2.8.4.2 Framed Prepared Openings

Openings shall have 1 inch clearance between the duct and the opening or 1 inch clearance between the insulation and the opening for insulated ducts.

##### 2.8.4.3 Closure Collars

Collars shall be fabricated of galvanized sheet metal not less than 4 inches wide, unless otherwise indicated, and shall be installed on exposed ducts on each side of walls or floors where sleeves or prepared openings are provided. Collars shall be installed tight against surfaces. Collars shall fit snugly around the

duct or insulation. Sharp edges of the collar around insulated duct shall be ground smooth to preclude tearing or puncturing the insulation covering or vapor barrier. Collars for round ducts 15 inches in diameter or less shall be fabricated from 20 gauge galvanized steel. Collars for round ducts larger than 15 inches and square, and rectangular ducts shall be fabricated from 18 gauge galvanized steel. Collars shall be installed with fasteners on maximum 6 inch centers, except that not less than 4 fasteners shall be used.

#### 2.8.5 NOT USED

#### 2.8.6 Acoustical Duct Liner

Acoustical duct lining shall be fibrous glass designed exclusively for lining ductwork and shall conform to the requirements of ASTM C 1071, Type I and II. Liner composition may be uniform density, graduated density, or dual density, as standard with the manufacturer. Lining shall be coated, not less than 1 inch thick. Where acoustical duct liner is used, liner or combination of liner and insulation applied to the exterior of the ductwork shall be the thermal equivalent of the insulation specified in Section C-15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Duct sizes shown shall be increased to compensate for the thickness of the lining used. In lieu of sheet metal duct with field-applied acoustical lining, acoustically equivalent lengths of fibrous glass duct or factory fabricated double-walled internally insulated duct with perforated liner may be provided. Net insertion loss value, static pressure drop, and air flow velocity capacity data shall be certified by a nationally recognized independent acoustical laboratory.

#### 2.8.7 Diffusers, Registers, and Grilles

Units shall be factory-fabricated of steel, corrosion-resistant steel, or aluminum and shall distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area. Outlets for diffusion, spread, throw, and noise level shall be as required for specified performance. Performance shall be certified according to ASHRAE 70. Inlets and outlets shall be sound rated and certified according to ASHRAE 70. Sound power level shall be as indicated. Diffusers and registers shall be provided with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device will be acceptable. Volume dampers shall be opposed blade type for all diffusers and registers, except linear slot diffusers. Linear slot diffusers shall be provided with round or elliptical balancing dampers. Where the inlet and outlet openings are located less than 7 feet above the floor, they shall be protected by a grille or screen according to NFPA 90A.

##### 2.8.7.1 Diffusers

Diffuser types shall be as indicated. Ceiling mounted units shall be furnished with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Diffusers shall be provided with air deflectors of the type indicated. Air handling troffers or combination light and ceiling diffusers shall conform to the requirements of UL-03 for the interchangeable use as cooled or heated air supply diffusers or return air units. Ceiling mounted units shall be installed with rims tight against ceiling. Sponge rubber gaskets shall be provided between ceiling and surface mounted diffusers for air leakage control. Suitable trim shall be provided for flush mounted diffusers. Duct collar connecting the duct to diffuser shall be airtight and shall not interfere with volume controller. Return or exhaust units shall be similar to supply diffusers.

#### 2.8.7.2 Registers and Grilles

Units shall be four-way directional-control type, except that return and exhaust registers may be fixed horizontal or vertical louver type similar in appearance to the supply register face. Registers shall be provided with sponge-rubber gasket between flanges and wall or ceiling. Wall supply registers shall be installed at least 6 inches below the ceiling unless otherwise indicated. Return and exhaust registers shall be located 6 inches above the floor unless otherwise indicated. Four-way directional control may be achieved by a grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Grilles shall be as specified for registers, without volume control damper.

#### 2.8.8 Louvers

Louvers for installation in exterior walls suitable for the equipment shall have blades fabricated from anodized aluminum or galvanized steel sheets, and shall be provided with a frame of galvanized steel or aluminum structural shapes. Sheet metal thickness and fabrication shall conform to the SMACNA-06. Blades shall be accurately fitted and secured to frames. Edges of louver blades shall be folded or beaded for rigidity and baffled to exclude driving rain. Louver shall be provided with bird screen. Louvers shall bear AMCA certified ratings seal for air performance and water penetration ratings as described in AMCA 500.

#### 2.8.9 Air Vents

Air vents shall be fabricated from galvanized steel or aluminum sheets with galvanized or aluminum structural shapes. Sheet metal thickness, reinforcement, and fabrication shall conform to SMACNA-06. Air vents and goosenecks shall be provided with bird screen.

#### 2.8.10 Bird Screens and Frames

Bird screens shall conform to ASTM E 437, Type I, Class 1, 1/2" by 1/2" mesh, 0.063 inch diameter aluminum wire or 0.031 inch diameter stainless steel wire. Frames shall be removable type of stainless steel or extruded aluminum.

#### 2.8.11 Radon Exhaust Ductwork

Radon exhaust ductwork installed in or beneath slabs shall be fabricated from Schedule 40 PVC pipe that conforms to ASTM D 1785. Fittings shall conform to ASTM D 2466. Solvent cement used to make joints shall conform to ASTM D 2564. Otherwise radon exhaust ductwork shall be metal as specified herein.

### 2.9 AIR SYSTEMS EQUIPMENT

#### 2.9.1 Fans

Fans shall be tested and rated according to AMCA 210. Fans may be connected to the motors either directly or indirectly with V-belt drive. V-belt drives shall be designed for not less than 140 percent of the connected driving capacity. Motor sheaves shall be variable pitch for 15 hp and below and fixed pitch as defined by ARI Guideline D. Variable pitch sheaves shall be selected to drive the fan at a speed which will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, a replaceable sheave shall be provided when needed to achieve system air balance. Motors for V-belt drives shall be provided with adjustable rails or bases. Removable metal guards shall be provided for all exposed V-belt drives, and speed-test openings shall be provided at the center of all rotating shafts. Fans shall be provided with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise

indicated, where ducts are connected to the fan. Fan and motor assemblies shall be provided with vibration-isolation supports or mountings as indicated. Vibration-isolation units shall be standard products with published loading ratings. Each fan shall be selected to produce the capacity required at the fan static pressure indicated. Sound power level shall be as indicated. The sound power level values shall be obtained according to AMCA 300. Standard AMCA arrangement, rotation, and discharge shall be as indicated.

#### 2.9.1.1 Centrifugal Fans

Centrifugal fans shall be fully enclosed, single-width single-inlet, or double-width double-inlet, AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Impeller wheels shall be rigidly constructed, accurately balanced both statically and dynamically. Fan blades may be forward curved, backward-inclined or airfoil design in wheel sizes up to 30 inches. Fan blades for wheels over 30 inches in diameter shall be backward-inclined or airfoil design. Fan wheels over 36 inches in diameter shall have overhung pulleys and a bearing on each side of the wheel. Fan wheels 36 inches or less in diameter may have one or more extralong bearings between the fan wheel and the drive. Bearings shall be sleeve type, self-aligning and self-oiling with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings or permanently lubricated type. Grease fittings shall be connected to tubing and serviceable from a single accessible point. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABEMA 9 and ABEMA 11. Fan shafts shall be steel, accurately finished, and shall be provided with key seats and keys for impeller hubs and fan pulleys. Each fan outlet shall be of ample proportions and shall be designed for the attachment of angles and bolts for attaching flexible connections. Motors, unless otherwise indicated, shall not exceed 1800 rpm and shall have dripproof enclosures.

#### 2.9.1.2 In-Line Centrifugal Fans

In-line fans shall have centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and adjustable motor mounts. Fans shall be mounted in a welded tubular casing. Air shall enter and leave the fan axially. Inlets shall be streamlined with conversion vanes to eliminate turbulence and provide smooth discharge air flow. Fan bearings and drive shafts shall be enclosed and isolated from the air stream. Fan bearings shall be sealed against dust and dirt and shall be permanently lubricated, and shall be precision self aligning ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABEMA 9 and ABEMA 11. Motors shall have open enclosure.

#### 2.9.1.3 Vane Axial Fans

Vane axial fans shall be complete with drive components and belt guard, and shall have a steel housing, cast fan wheel, cast or welded steel diffusers, fan shaft, bearings, and mounting frame as a factory-assembled unit. Fan wheels shall have radially projecting blades of airfoil cross section and shall be dynamically balanced and keyed to the fan shaft. Fan bearings and drive shafts shall be enclosed and isolated from the air stream. Fan bearings shall be sealed against dust and dirt, shall be permanently lubricated or with accessible grease fittings, and shall be precision self-aligning ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours of operation as defined by ABEMA 9 and ABEMA 11. Fan inlets shall be provided with an aerodynamically shaped bell and an inlet cone. Diffuser or straightening vanes shall be provided at the fan discharge to minimize turbulence and provide smooth discharge air flow. Fan unit shall be provided with inlet and outlet flanges. Unless otherwise indicated, motors shall not exceed 1800 rpm and shall have dripproof enclosure.

#### 2.9.1.4 NOT USED

#### 2.9.1.5 Centrifugal Type Power Wall Ventilators

Fans shall be direct or V-belt driven as indicated, centrifugal type with backward inclined, non-overloading wheel. Motor housing shall be removable and weatherproof. Unit housing shall be designed for sealing to building surface and for discharge and condensate drippage away from building surface. Housing shall be constructed of heavy gauge aluminum. Unit shall be fitted with an aluminum or plated steel wire discharge bird screen, manufacturer's standard gravity or motor-operated damper as scheduled, and an airtight and liquid-tight metallic wall sleeve. Motor enclosure shall be drip-proof type. Lubricated bearings shall be provided.

#### 2.9.1.6 Centrifugal Type Power Roof Ventilators

Fans shall be direct or V-belt driven as indicated with backward inclined, non-overloading wheel. Motor compartment housing shall be hinged or removable and weatherproof, constructed of heavy gauge aluminum. Fans shall be provided with birdscreen, disconnect switch, and gravity or motorized dampers, as scheduled. Motors enclosure shall be drip-proof type. Lubricated bearings shall be provided.

#### 2.9.1.7 NOT USED

#### 2.9.1.8 NOT USED

#### 2.9.1.9 NOT USED

#### 2.9.2 Coils

Coils shall be fin-and-tube type constructed of seamless copper tubes and aluminum fins mechanically bonded or soldered to the tubes. Copper tube wall thickness shall be a minimum of 0.020 inches. Aluminum fins shall be 0.0075 inch minimum thickness. Casing and tube support sheets shall be not lighter than 16 gauge galvanized steel, formed to provide structural strength. When required, multiple tube supports shall be provided to prevent tube sag. Each coil shall be tested at the factory under water at not less than 400 psi air pressure and shall be suitable for 200 psi working pressure. Coils shall be mounted for counterflow service. Coils shall be rated and certified according to ARI 410.

##### 2.9.2.1 Direct-Expansion Coils

Direct-expansion coils shall be suitable for the refrigerant involved. Suction headers shall be seamless copper tubing or seamless or resistance welded steel tube with copper connections. Supply headers shall consist of a distributor which shall distribute the refrigerant through seamless copper tubing equally to all circuits in the coil. Tubes shall be circuited to ensure minimum pressure drop and maximum heat transfer. Circuiting shall permit refrigerant flow from inlet to suction outlet without causing oil slugging or restricting refrigerant flow in coil. Each coil to be field installed shall be completely dehydrated and sealed at the factory upon completion of pressure tests.

##### 2.9.2.2 Water Coils

Water coils shall be installed with a pitch of not less than 1/8 inch per foot of the tube length toward the drain end. Headers shall be constructed of cast iron, welded steel or copper. Each coil shall be provided with a plugged vent and drain connection extending through the unit casing.

##### 2.9.2.3 NOT USED

2.9.2.4 NOT USED

2.9.3 Air Filters

Air filters shall be listed according to requirements of UL 900.

2.9.3.1 Extended Surface Pleated Panel Filters

Filters shall be 2 inch depth, sectional, disposable type of the size indicated and shall have an average efficiency of 25 to 30 percent when tested according to ASHRAE 52.1. Initial resistance at 500 feet per minute shall not exceed 0.36 inches water gauge. Filters shall be UL Class 2. Media shall be nonwoven cotton and synthetic fiber mat. A wire support grid bonded to the media shall be attached to a moisture resistant fiberboard frame. All four edges of the filter media shall be bonded to the inside of the frame to prevent air bypass and increase rigidity.

2.9.3.2 NOT USED

2.9.3.3 NOT USED

2.9.3.4 NOT USED

2.9.3.5 NOT USED

2.9.3.6 NOT USED

2.9.3.7 NOT USED

2.9.3.8 NOT USED

2.9.3.9 Holding Frames

Frames shall be fabricated from not lighter than 16-gauge sheet steel with rust-inhibitor coating. Each holding frame shall be equipped with suitable filter holding devices. Holding frame seats shall be gasketed. All joints shall be airtight.

2.9.3.10 Filter Gauges

Filter gauges shall be dial type, diaphragm actuated draft and shall be provided for all filter stations, including those filters which are furnished as integral parts of factory fabricated air handling units. Gauges shall be at least 3-7/8 inches in diameter, shall have white dials with black figures, and graduations and shall have a minimum range of 1 inch beyond the specified final resistance for the filter bank on which each gauge is applied. Each gauge shall incorporate a screw operated zero adjustment and shall be furnished complete with two static pressure taps with integral compression fittings, two molded plastic vent valves, two 5 foot minimum lengths of 1/4 inch diameter aluminum or vinyl tubing, and all hardware and accessories for gauge mounting.

2.10 AIR HANDLING UNITS

2.10.1 NOT USED

2.10.2 Factory-Fabricated Air Handling Units

Units shall be single-zone draw-through type as indicated. Units shall include fans, coils, airtight insulated casing, filters, adjustable V-belt drives, belt guards for externally mounted motors, access sections where indicated,



combination sectional filter-mixing box, vibration-isolators, and appurtenances required for specified operation. Vibration isolators shall be as indicated. Each air handling unit shall have physical dimensions suitable to fit space allotted to the unit and shall have the capacity indicated. Air handling unit shall have published ratings based on tests performed according to ARI 430.

#### 2.10.2.1 Casings

Casing sections shall be single wall type as indicated, constructed of a minimum 18 gauge galvanized steel, or 18-gauge steel outer casing protected with a corrosion resistant paint finish. Casing shall be designed and constructed with an integral structural steel frame such that exterior panels are non-load bearing. Exterior panels shall be individually removable. Removal shall not affect the structural integrity of the unit. Casings shall be provided with inspection doors, access sections, and access doors as indicated. Inspection and access doors shall be insulated, fully gasketed, double-wall type, of a minimum 18-gauge outer and 20-gauge inner panels. Doors shall be rigid and provided with heavy duty hinges and latches. Inspection doors shall be a minimum 12 inches wide by 12 inches high. Access doors shall be minimum 24 inches wide and shall be the full height of the unit casing or a minimum of 6 ft., whichever is less. Access Sections shall be according to paragraph AIR HANDLING UNITS. Drain pan shall be double-bottom type constructed of 16 gauge galvanized steel or stainless steel, pitched to the drain connection. Drain pans shall be constructed water tight, treated to prevent corrosion, and designed for positive condensate drainage. When 2 or more cooling coils are used, with one stacked above the other, condensate from the upper coils shall not flow across the face of lower coils. Intermediate drain pans or condensate collection channels and downspouts shall be provided, as required to carry condensate to the unit drain pan out of the air stream and without moisture carryover. Each casing section handling conditioned air shall be insulated with not less than 1 inch thick, 1-1/2 pound density coated fibrous glass material having a thermal conductivity not greater than 0.23 Btu/hr-sf-F. Factory applied fibrous glass insulation shall conform to ASTM C 1071, except that the minimum thickness and density requirements do not apply, and shall meet the requirements of NFPA 90A. Foam-type insulation is not acceptable. Foil-faced insulation shall not be an acceptable substitute for use on double-wall access doors and inspections doors and casing sections. Duct liner material, coating, and adhesive shall conform to fire-hazard requirements specified in Section C-15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Exposed insulation edges and joints where insulation panels are butted together shall be protected with a metal nosing strip or shall be coated to conform to meet erosion resistance requirements of ASTM C 107. A latched and hinged inspection door, shall be provided in the fan and coil sections. Additional inspection doors, access doors and access sections shall be provided where indicated.

#### 2.10.2.2 Heating and Cooling Coils

Coils shall be provided as specified in paragraph AIR SYSTEMS EQUIPMENT, for types indicated.

#### 2.10.2.3 NOT USED

#### 2.10.2.4 Air Filters

Air filters shall be as specified in paragraph AIR SYSTEMS EQUIPMENT for types and thickness indicated.

#### 2.10.2.5 Fans

Fans shall be double-inlet, centrifugal type with each fan in a separate scroll. Fans and shafts shall be dynamically balanced prior to installation into air

handling unit, then the entire fan assembly shall be statically and dynamically balanced at the factory after it has been installed in the air handling unit. Fans shall be mounted on steel shafts accurately ground and finished. Fan bearings shall be sealed against dust and dirt and shall be precision self-aligning ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABEMA 9 and ABEMA 11. Bearings shall be permanently lubricated or lubricated type with lubrication fittings readily accessible at the drive side of the unit. Bearings shall be supported by structural shapes, or die formed sheet structural members, or support plates securely attached to the unit casing. Bearings may not be fastened directly to the unit sheet metal casing. Fans and scrolls shall be furnished with coating indicated. Fans shall be driven by a unit-mounted or a floor-mounted motor connected to fans by V-belt drive complete with belt guard for externally mounted motors. Belt guards shall be the three sided enclosed type with solid or expanded metal face. Belt drives shall be designed for not less than a 1.3 service factor based on motor nameplate rating. Motor sheaves shall be variable pitch for 25 hp and below and fixed pitch above 25 hp as defined by ARI Guideline D. Where fixed sheaves are required, variable pitch sheaves may be used during air balance, but shall be replaced with an appropriate fixed sheave after air balance is completed. Variable pitch sheaves shall be selected to drive the fan at a speed that will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. Motors for V-belt drives shall be provided with adjustable bases. Fan motors shall have open enclosures. Unit fan or fans shall be selected to produce the required capacity at the fan static pressure. Sound power level shall be as indicated. The sound power level values shall be obtained according to AMCA 300 or ASHRAE 68.

#### 2.10.2.6 Access Sections and Filter Boxes

Access sections shall be provided where indicated and shall be furnished with access doors as shown. Access sections and filter boxes shall be constructed in a manner identical to the remainder of the unit casing and shall be equipped with access doors. Mixing boxes shall be designed to minimize air stratification and to promote mixing of the air streams.

#### 2.10.2.7 NOT USED

#### 2.10.2.8 Dampers

Dampers shall be as specified in paragraph CONTROLS.

### 2.11 TERMINAL UNITS

#### 2.11.1 NOT USED

#### 2.11.2 NOT USED

#### 2.11.3 Variable Air Volume (VAV) Terminal Units

VAV terminal units shall be the type, size, and capacity shown and shall be mounted in the ceiling or wall cavity and shall be suitable for single duct system applications. Actuators and controls shall be as specified in paragraph CONTROLS. Unit enclosures shall be constructed of galvanized steel not lighter than 22-gauge or aluminum sheet not lighter than 18-gauge. Single or multiple discharge outlets shall be provided as required. Units with flow limiters are not acceptable. Unit air volume shall be factory preset and readily field adjustable without special tools. A flow chart shall be attached to each unit. Acoustic performance of the terminal units shall be based upon units tested according to ARI 880. Sound power level shall be as indicated. Discharge sound

power shall be shown for minimum and 1-1/2 inches water gauge inlet static pressure. Acoustical lining shall be according to NFPA 90A.

2.11.3.1 NOT USED

2.11.3.2 Variable Volume, Single Duct, Bypass

Variable volume, single duct, bypass terminal units shall be provided with a calibrated air volume sensing device, air valve or damper, actuator, and accessory relays. Units shall control air volume to within plus or minus 5 percent of each air set point volume as determined by the thermostat with variations in inlet pressures from 3/4 inch to 6 inch water gauge. Internal resistance of units shall not exceed 0.4 inch water gauge at maximum flow range. External differential pressure taps separate from the control pressure taps shall be provided for air flow measurement with a 0 to 1 inch water gauge range. Unit volume controller shall be normally open upon loss of pneumatic pressure.

2.11.3.3 NOT USED

2.11.3.4 NOT USED

2.11.3.5 NOT USED

2.11.3.6 NOT USED

2.11.4 NOT USED

2.12 NOT USED

2.13 NOT USED

## PART 3 EXECUTION

### 3.1 INSTALLATION

Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.

3.1.1 NOT USED

3.1.2 NOT USED

3.1.3 NOT USED

3.1.4 NOT USED

#### 3.1.5 Condensate Drain Lines

Water seals shall be provided in the condensate drain from all units. The depth of each seal shall be 2 inches plus the number of inches, measured in water gauge, of the total static pressure rating of the unit to which the drain is connected. Water seals shall be constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Pipe cap or plug cleanouts shall be provided where indicated. Drains indicated to connect to the sanitary waste system shall be connected by an indirect waste fitting. Air handling unit drain lines shall be insulated as specified in Section C-15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.1.6 NOT USED

3.1.7 NOT USED

3.1.8 NOT USED

### 3.1.9 Equipment and Installation

Frames and supports shall be provided for air handling units, fans, coils, dampers, and other similar items requiring supports. Air handling units shall be floor mounted or ceiling hung, as indicated. The method of anchoring and fastening shall be as detailed. Floor-mounted equipment, unless otherwise indicated, shall be set on not less than 6 inch concrete pads or curbs doweled in place. Foundation drawings, bolt-setting information, and foundation bolts shall be furnished prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Concrete for foundations shall be as specified in Section C-03300 CONCRETE FOR BUILDING CONSTRUCTION.

### 3.1.10 Access Panels

Access panels shall be provided for concealed controls, dampers, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in Section C-05500 MISCELLANEOUS METALS.

### 3.1.11 Flexible Connectors

Pre-insulated flexible connectors and flexible duct shall be attached to other components in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the connectors, shall be of the type recommended by the connector or duct manufacturer and shall be provided at the intervals recommended.

### 3.1.12 Sleeved and Framed Openings

Space between the sleeved or framed opening and the duct or the duct insulation shall be packed as specified in Section C-07270 FIRESTOPPING for fire rated penetrations. For non-fire rated penetrations, the space shall be packed as specified in Section C-07920 CAULKING AND SEALANTS.

### 3.1.13 Metal Ductwork

Installation shall be according to SMACNA-06 unless otherwise indicated. Duct supports for sheet metal ductwork shall be according to SMACNA-06, unless otherwise specified. Friction beam clamps indicated in SMACNA-06 shall not be used. Risers on high velocity ducts shall be anchored in the center of the vertical run to allow ends of riser to move due to thermal expansion. Supports on the risers shall allow free vertical movement of the duct. Supports shall be attached only to structural framing members and concrete slabs. Supports shall not be anchored to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, suitable intermediate metal framing shall be provided. Where C-clamps are used, retainer clips shall be provided.

#### 3.1.13.1 Underground Ductwork

Underground ductwork shall be fabricated of Sch. 40 PVC pipe or standard weight DWV PVC pipe with solvent welded joints and fittings. Ductwork shall be installed as indicated, according to ACCA Manual 4 and manufacturer's instructions. Maximum burial depth shall be 6 feet.

3.1.13.2 NOT USED

3.1.13.3 NOT USED

#### 3.1.14 Fibrous Glass Ductwork

Installation shall be according to the manufacturer's written recommendations unless otherwise required in NAIMA-01. Duct supports for fibrous glass ductwork shall conform to NAIMA-01. In those cases not covered in NAIMA-01, the written recommendation of the fibrous duct manufacturer shall be followed.

3.1.15 NOT USED

3.1.16 NOT USED

#### 3.1.17 Acoustical Duct Lining

Lining shall be applied in cut-to-size pieces attached to the interior of the duct with non-flammable fire-resistant adhesive conforming to ASTM C 916, Type I, NFPA 90A, UL 723 and ASTM E84. Top and bottom pieces shall lap the side pieces and shall be secured with welded pins, adhered clips of metal, nylon, or high impact plastic, and speed washers or welding cup-head pins installed according to SMACNA-06. Welded pins, cup-head pins, or adhered clips shall not distort the duct, burn through, nor mar the finish or the surface of the duct. Pins and washers shall be flush with the surfaces of the duct liner and all breaks and punctures of the duct liner coating shall be sealed with non-flammable fire-resistant adhesive. Exposed edges of the liner at the duct ends and at other joints where the lining will be subject to erosion shall be coated with a heavy brush coat of non-flammable fire-resistant adhesive, to prevent delamination of glass fibers. Duct liner may be applied to flat sheet metal prior to forming duct through the sheet metal brake. Lining at the top and bottom surfaces of the duct shall be additionally secured by welded pins or adhered clips as specified for cut-to-size pieces. Other methods indicated in SMACNA-06 to obtain proper installation of duct liners in sheet metal ducts, including adhesives and fasteners, will be acceptable.

#### 3.1.18 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, temporary dust control protection shall be provided. The distribution system (supply and return) shall be protected with temporary seal-offs at all inlets and outlets at the end of each day's work. Temporary protection shall remain in place until system is ready for startup.

#### 3.1.19 Insulation

Thickness and application of insulation materials for ductwork, piping, and equipment shall be according to Section C-15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Outdoor air intake ducts and plenums shall be externally insulated up to the point where the outdoor air reaches the conditioning unit or up to the point where the outdoor air mixes with the outside air stream.

#### 3.1.20 Duct Test Holes

Holes with closures or threaded holes with plugs shall be provided in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Extensions, complete with cap or plug, shall be provided where the ducts are insulated.

### 3.1.21 Power Roof Ventilator Mounting

Foamed 1/2 inch thick, closed-cell, flexible elastomer insulation shall cover width of roof curb mounting flange. Where wood nailers are used, holes shall be pre-drilled for fasteners.

### 3.1.22 Power Transmission Components Adjustment

V-belts and sheaves shall be tested for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Belts on drive side shall be uniformly loaded, not bouncing. Alignment of direct driven couplings shall be to within 50 percent of manufacturer's maximum allowable range of misalignment.

## 3.2 FIELD PAINTING AND PIPING IDENTIFICATION

Finish painting of items only primed at the factory or surfaces not specifically noted otherwise and identification for piping are specified in Section C-09900 PAINTING, GENERAL.

### 3.3 NOT USED

### 3.4 NOT USED

## 3.5 CLEANING AND ADJUSTING

Inside of air terminal units, ducts, plenums, and casing shall be thoroughly cleaned of debris and blown free of small particles of rubbish and dust and then shall be vacuum cleaned before installing outlet faces. Equipment shall be wiped clean, with traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided prior to startup of all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

## 3.6 TESTING, ADJUSTING, AND BALANCING

Testing, adjusting, and balancing shall be as specified in Section C-15990 TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS. Testing, adjusting, and balancing shall begin only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

## 3.7 PERFORMANCE TESTS

After testing, adjusting, and balancing has been completed as specified, each system shall be tested as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Corrections and adjustments shall be made as necessary to produce the conditions indicated or specified. Capacity tests and general operating tests shall be conducted by an experienced engineer. Tests shall cover a period of not less than 2 days for each system and shall demonstrate that the entire system is functioning according to the specifications. Coincidental chart recordings shall be made at points indicated on the drawings for the duration of the time period and shall record the temperature at space thermostats or space

sensors, and the ambient temperature and humidity in a shaded and weather protected area.

### 3.8 FIELD TRAINING

The Contractor shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 8 hours of normal working time and shall start after the system is functionally complete but prior to the performance tests. The field instruction shall cover all of the items contained in the approved Operating and Maintenance Instructions.

--End of Section--

## SECTION C-15940

### OVERHEAD VEHICLE TAILPIPE EXHAUST SYSTEM

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

#### AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 210 (1985) Laboratory Methods of Testing Fans for Rating

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M (1996) Carbon Structural Steel

ASTM A 53 (1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

ASTM A 167 (1993) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

ASTM A 193/A 193M (1996) Alloy-Steel and Stainless Steel Bolting Machine Materials for High-Temperature Service

ASTM A 307 (1994) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A 525 (1991) General Requirement for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

ASTM A 569/A 569M (1996) Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality

ASTM A 924/A 924M (1996a) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

ASTM B 32 (1996) Solder Metal

ASTM B 117 (1995) Salt Spray (Fog) Testing

ASTM E 437 (1992) Industrial Wire Cloth and Screens (Square Opening Series)

#### AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME-17 (1989; Addenda 1989, 1990, 1991) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

ASME B16.21 (1978) Nonmetallic Flat Gasket for Pipe Flanges



ASME BPV IX (1995; Addenda Dec 1995, Dec 1996) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8 (1992) Filler Metals for Brazing and Braze Welding

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA-08 (1977) Round Industrial Duct Construction Standards

1.2 GENERAL REQUIREMENTS

1.2.1 Standard Products

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Where an integrated, packaged exhaust system is furnished, all items will be the product of the system manufacturer. System component parts may be by other manufacturers. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

1.2.2 Nameplates

Each major component of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the equipment.

1.2.3 Equipment Guards and Access

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

1.2.4 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field and advise the Contracting Officer of any discrepancy before performing the work.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Exhaust System; GA.

Spare parts data for each different item of material and equipment specified, after approval of detail drawings and not later than 3 months before the date of

beneficial occupancy. Data shall include a complete list of parts and supplies with current unit prices and source of supply.

#### SD-04 Drawings

Exhaust System; GA.

Detail drawings consisting of a complete list of equipment and materials, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Detail drawings shall also contain complete duct, wiring, and schematic diagrams and any other details to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment in relation to other parts of the work including clearances required for maintenance and operation.

#### SD-06 Instructions

Exhaust System; FIO.

Proposed diagrams, instructions, and other sheets, prior to posting. Framed instructions under glass or in laminated plastic shall be posted where directed, including wiring and control diagrams showing the complete layout of the entire system. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

#### SD-09 Reports

Tests; FIO.

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

#### SD-19 Operation and Maintenance Manuals

Exhaust System; GA.

Six complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The instructions shall include duct and equipment layout and simplified wiring and control diagrams of the system as installed.

#### 1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants.

#### PART 2 PRODUCTS

## 2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall conform to the following requirements.

### 2.1.1 Screen

ASTM E 437, type and class as required for the application.

### 2.1.2 Iron and Steel Sheets

#### 2.1.2.1 Galvanized Iron and Steel

ASTM A 924/A 924 M, Coating Designation G90.

#### 2.1.2.2 Uncoated Steel

ASTM A 569/A 569M, condition, and type best suited to intended use.

#### 2.1.2.3 Stainless Steel

ASTM A 167, Type 304.

### 2.1.3 Steel Structural Shapes

ASTM A 36/A 36M.

### 2.1.4 Solder Silver

AWS A 5.8, brazing alloy; grade to suit application.

### 2.1.5 Solder

ASTM B32, composition to suit application.

### 2.1.6 Bolts and Nuts

Bolts and nuts, except as required for high temperature exhaust applications, shall be in accordance with ASTM A 307. Bolts and nuts used for exhaust applications where the temperature of the bolt may rise above 400 degrees F or used as flange bolts in corrosion resistant material shall be in accordance with ASTM A 193/A 193M Class 2. The bolt head shall be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A 307 or ASTM A 193/A 193M as applicable.

## 2.2 ELECTRICAL WORK

Electrical motor-driven equipment shall be provided complete with high efficiency motors and controls. Electrical equipment, wiring, and motor efficiencies shall be in accordance with Section C-16415 ELECTRICAL WORK, INTERIOR. Manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for control devices but not shown, shall be provided.

## 2.3 AIR MOVING DEVICES

### 2.3.1 General

Fans shall be tested and rated in accordance with the standards of AMCA 210. Fans having a capacity of 400 cubic feet per minute or greater will be indirectly

connected to the motor by a V-belt drive. Where V-belt drives are used, such drives shall be designed for not less than 150 percent of the connected driving capacity, and motor sheaves shall be adjustable to provide not less than an overall 20 percent speed variation. Sheaves shall be selected to drive the fan at such speed as to produce the specified capacity when set at the approximate midpoint of the sheave adjustment. Motors for V-belt drives shall be provided with adjustable rails or bases. Fans shall be provided with personnel screens or guards on both suction and supply ends except where ducts or dampers are connected to the fan. Fans and motors shall be provided with vibration isolation supports or mountings. Vibration isolation units shall be standard products with published load ratings, and shall be single rubber-in-shear, neoprene coated fiberglass, double rubber-in-shear springs, or springs under inertia base. Each fan shall be selected to produce the capacity required at the fan total pressure indicated. Standard AMCA arrangements shall be provided unless otherwise indicated and the rotation and discharge shall be as indicated. Fans shall have nonoverloading characteristics. Fan housing shall be constructed with not less than 16-gauge thickness of steel. Fan impellers shall be constructed of heavy gauge steel and accurately balanced both statically and dynamically when installed in the assembled fan unit. Impeller and housing in the air stream shall be coated with neoprene, epoxy, phenolic resins, or other approved material suitable to resist the corrosive gases and temperatures produced. Fans shall be free of objectionable vibration or noise. Certified performance curves indicating that the fan supplied will operate in its most efficient operating range will be provided. In addition, "sound power" ratings shall be furnished with each fan. Fans indicated to be mounted on exterior of building shall be provided with weatherproof covers for the motor drive unit or other weatherproofing as recommended by the manufacturer. Each fan shall be selected to produce the capacity required at the fan total pressure indicated. Weather hoods, flashing, and bird screens shall be provided where indicated.

### 2.3.2 Centrifugal Fans

Centrifugal fans shall be fully enclosed, single-width, single-inlet or double-width, double-inlet, as required or indicated. Impeller wheels shall have backward-inclined or backward-curved blades of the nonoverloading type. Fan wheels over 36-inches diameter shall have overhung pulleys and a bearing on each side of the wheel. Fan wheels 36 inches or less in diameter may have one or more extra-long bearings between the fan wheel and the drive. The bearings shall be self-aligned ball-bearing type with provisions for lubrication. Fan shafts shall be steel, accurately finished, and shall be provided with key and key seats for impeller hubs and fan pulleys. The fans shall be furnished with factory-finish coating. Motor shall have open enclosure, unless otherwise indicated.

### 2.3.3 NOT USED

## 2.4 DUCTWORK

### 2.4.1 General

Duct shall be constructed of stainless steel sheets of the minimum gauge thickness for ducts as required in SMACNA-08. Ducts shall be constructed and sealed in accordance with SMACNA-08 for a negative pressure of 3-inch water gauge static pressure. Ducts, unless otherwise approved, shall be round with longitudinal lock seam and conform to the dimensions indicated. Ducts shall be straight and smooth on the inside with airtight joints. Where ducts with crimped ends are used to make up joints, the joints shall have crimp and bead. The bead shall provide a rigid stop for the mating open end to seat against. Steel spiral wound duct is not acceptable.

#### 2.4.2 Fittings

Reducing fittings shall have a minimum of 1-inch increase in diameter per 8 inches in length. Elbows shall have a centerline radius of not less than 1-1/2 times the diameter. Branches shall stub into mains at main expansion points at an angle of not more than 30 degrees with the centerline of the main duct in the direction of air flow, unless otherwise indicated or approved. Where riser ducts with single or multiple inlets are indicated, the riser duct shall connect into the bottom of the main duct at an angle as specified for branches. Where flexible connections connect to the main duct, the duct branch takeoff or stub shall be braced with approved metal straps or members.

#### 2.4.3 Cleanout

Cleanout shall be provided on the end of the main ductwork opposite the end of the fan suction connection. The cleanout opening shall be sized to the approximate inside area of the duct. Removable airtight caps or flange type covers of minimum gauge thickness as the main duct shall be provided. Other cleanout openings shall be provided where indicated.

#### 2.4.4 Apparatus Connections

Where sheet metal connections are made to fan suction and discharge, or where ducts of dissimilar metals are connected, an approved noncombustible flexible connection approximately 6 inches wide shall be installed and securely fastened by zinc-coated steel clinch-type draw bands for round ducts. For rectangular ducts the flexible connections locked to metal collars shall be installed using normal duct construction methods.

#### 2.4.5 Duct Test Holes

Test holes with covers shall be provided where indicated, directed, or where necessary in ducts and plenums for using Pitot tubes for taking air measurements to balance the air systems.

#### 2.4.6 Duct Sleeves and Framed Openings

Duct sleeves shall be provided for all round ducts 15-inch diameter or less passing through floors, walls, ceilings, or roofs. Sleeves in nonload bearing walls shall be fabricated of 20-gauge steel sheets conforming to ASTM A 924/A 924M. Sleeves in load-bearing walls shall be fabricated of standard-weight galvanized steel pipe conforming to ASTM A 53. Round ducts larger than 15-inch diameter and all square and rectangular ducts passing through floors, walls, ceilings, or roofs shall be installed through framed openings. Structural steel members for framed openings shall conform to ASTM A 36/A 36M. Framed openings shall provide 1-inch clearance between the duct and the opening. Closure collar of galvanized steel not less than 4-inches wide shall be provided on each side of walls or floors where sleeves or framed openings are provided. Collars for round ducts 15-inch diameter or less shall be fabricated from 20-gauge, galvanized steel. Collars for round, square or rectangular ducts with minimum dimension over 15 inches shall be fabricated from 18-gauge, galvanized steel.

### 2.5 EXHAUST TUBING SYSTEM

#### 2.5.1 Tailpipe Adapters

Tailpipe adapters shall be fabricated of not less than 20-gauge stainless steel. Adapters shall be of the tapered-cone type with spring clips or other suitable

devices for exhaust pipe attachment. The adapter shall fit 2, 4 and 6-inch nominal diameter exhaust pipe.

#### 2.5.2 NOT USED

#### 2.5.3 Flexible Exhaust Tubing

Flexible exhaust tubing shall be one of the following: 0.012-inch minimum strip thickness of stainless steel; 0.012-inch minimum strip thickness of galvanized steel; approved heat-resistant wire-reinforced glass fiber and neoprene tubing; or approved heat-resistant wire reinforced glass fiber and silicone tubing. Flexible tubing inside diameter and length shall be as shown. The tubing shall hang from the bottom of the ductwork and shall be capable of being retracted into the ductwork with the flexible tubing suspension system.

#### 2.5.4 Flexible Tubing Suspension System

The flexible tubing suspension system shall retract the flexible tubing into the rigid duct mounted overhead when not in use; allowing it to be lowered to the operating level, when required. The suspension system shall be furnished complete with cable, pulleys, and operating mechanism. The suspension system shall be manually-operated winch type with safety ratchet lock or automatic brake having slip resistant hand grip.

#### 2.6 DAMPERS

Dampers shall be installed as required for proper system balancing and operation. Dampers shall be of the circular disk type with quadrant locking device or blast gate type. Damper blades shall be not less than 16-gauge thickness of stainless steel. Blast gate dampers shall be two piece construction with adjustable sliding gate and setscrew.

#### 2.7 FACTORY COATING

Equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturers standard finish except that items located outside of building shall have weather-resistant finishes that will withstand 500 hours exposure to the salt spray test specified in ASTM B 117, using a 5 percent sodium chloride solution as specified in ASTM B 117. Immediately after completion of the test, the specimen shall show no sign of blistering, wrinkling, cracking, or loss of adhesion, and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

##### 3.1.1 Exhaust System

The overhead exhaust system shall be installed as indicated and recommended by the manufacturer. Welding and brazing shall conform to ASME BPV IX. Horizontal sections of the main duct shall be installed with the longitudinal lock seam on the top. Slip joints shall be sealed in accordance with SMACNA-08. Riser duct shall be supported and anchored to the structure as indicated. Main duct shall be attached to the structural members of the building as recommended by SMACNA-08.

##### 3.1.2 Building Surface Penetrations

Sleeves or framed openings shall be utilized where duct penetrates building surfaces. Penetrations shall be sealed, and fireproofed in accordance with Section C-07270 FIRESTOPPING. The space between the sleeve or framed opening and the duct shall be packed with mineral wool or other approved material. Closure collars shall be installed around the duct on both sides of the penetrated surface. Collars shall fit tight against the building surfaces and snugly around the duct.

### 3.2 FIELD PAINTING AND FINISHING

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified in Section C-09900 PAINTING, GENERAL.

### 3.3 TESTS

Each exhaust system and inlet shall be balanced to produce the indicated air quantities within 10 percent at the conditions shown. Control devices shall be set to control at the points indicated or directed. Bearings shall be lubricated, and the speed, direction or rotation of each fan shall be checked. The running current of each motor shall be checked. Upon completion, and prior to acceptance of the installation, the exhaust system shall be tested at operating conditions to demonstrate satisfactory functional and operating efficiency. Operating tests shall cover a period of not less than 2 hours for each system, and all tests shall be conducted in the presence of the Contracting Officer. If tests do not demonstrate satisfactory operation of the exhaust system, deficiencies shall be corrected and retested. All instruments, facilities, and labor required to properly conduct the tests shall be provided by the Contractor. The electricity required for testing will be furnished by the Government.

### 3.4 TRAINING

The Contractor shall conduct a training course for the operating staff as designed by the Contracting Officer. The training period shall consist of a total 4 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the Operation and Maintenance Manuals, as well as demonstrations of routine maintenance operations. The Contracting Officer shall be notified at least 14 days prior to date of proposed conduction of the training course.

-- End of Section --

SECTION C-15950

HEATING, VENTILATING AND AIR CONDITIONING HVAC CONTROL SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 500 (1989) Test Methods for Louvers, Dampers and Shutters

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 269 (1994a) Seamless and Welded Austenitic Stainless Steel  
Tubing for General Service

ASTM B 88 (1996) Seamless Copper Water Tube

ASTM D 635 (1991) Rate of Burning and/or Extent and Time of Burning  
of Self-Supporting Plastics in a Horizontal Position

ASTM D 1693 (1994) Environmental Stress-Cracking of Ethylene  
Plastics

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.34 (1988) Valves - Flanged, Threaded, and Welding End

ASME B40.1 (1991) Gauges - Pressure Indicating Dial Type - Elastic  
Element

ASME BPV VIII Div 1 (1995; Addenda Dec 1995) Boiler and Pressure Vessel  
Code; Section VIII, Pressure Vessels Division 1 - Basic  
Coverage

CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 15 Radio Frequency Devices

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991) Surge Voltages in Low-Voltage AC Power Circuits

INTERNATIONAL SOCIETY FOR MEASUREMENT AND CONTROL (ISA)

ISA S7.3 (1975; R 1981) Quality Standard for Instrument Air

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1991) Enclosures for Electrical Equipment (1000 Volts  
Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code



NFPA 90A (1993) Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 94 (1996) Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

UL 268A (1993; Rev Apr 1994) Smoke Detectors for Duct Application

UL 508 (1993) Industrial Control Equipment

UL 555S (1996) Leakage Rated Dampers for Use in Smoke-Control Systems

UL 916 (1994; Rev thru May 1996) Energy Management Equipment

## 1.2 GENERAL REQUIREMENTS

### 1.2.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

### 1.2.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall investigate the mechanical, electrical, and finish conditions that could affect the work to be performed, shall arrange such work accordingly, and shall furnish all work necessary to meet such conditions.

1.2.3 Hardware or software required to process date and time calculations shall be Year 2000 compliant and shall be capable to accurately process date/time data (including but not limited to calculating, comparing, and sequencing) from, into, and in between the twentieth and twenty-first centuries, including leap year calculations, when used in accordance with the product documentation provided by the contractor, provided that all products (e.g. hardware, software, firmware) used in combination with other information technology, shall accurately process date/time data if the other information technology properly exchanges date/time data with it.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment Compliance Booklet; GA

An HVAC control system equipment compliance booklet (ECB) in indexed booklet form with numbered tabs separating the information on each device. It shall consist of, but not be limited to, data sheets and catalog cuts which document compliance of all devices and components with the specifications. The ECB shall be indexed in alphabetical order by the unique identifiers. Devices and components which do not have unique identifiers shall follow the devices and

components with unique identifiers and shall be indexed in alphabetical order according to their functional name. The ECB shall include a bill of materials for each HVAC control system. The bill of materials shall function as the table of contents for the ECB and shall include the device's unique identifier, device function, manufacturer, model/part/catalog number used for ordering, and tab number where the device information is located in the ECB.

#### SD-04 Drawings

##### HVAC Control System; GA

Drawings on A1 34 by 22 inch sheets in the form and arrangement shown. The drawings shall use the same abbreviations, symbols, nomenclature and device identifiers shown. Each control-system element on a drawing shall have a unique identifier as shown. All HVAC control system drawings shall be delivered together as a complete submittal. Drawings shall be submitted for each HVAC system.

- a. HVAC control system drawings shall include the following:

Sheet One: Drawing index, HVAC control system legend.

Sheet Two: Valve schedule, damper schedule.

Sheet Three: HVAC control system schematic and equipment schedule.

Sheet Four: HVAC control system sequence of operation and ladder diagram.

Sheet Five: HVAC control panel arrangement, control panel cross-section, and control panel inner door layout.

Sheet Six: HVAC control panel back-panel layout.

Sheet Seven: Control loop wiring diagrams.

Sheet Eight: Motor starter and relay wiring diagram.

Note: Repeat sheets three through eight for each AHU system.

- b. An HVAC control system drawing index showing the name and number of the building, military site, State or other similar designation, and Country. The drawing index shall list all HVAC control system drawings, including the drawing number, sheet number, drawing title, and computer filename when used.

- c. An HVAC control system legend showing generic symbols and the name of devices shown on the HVAC control system drawings.

- d. A valve schedule showing each valve's unique identifier, size, flow coefficient (Cv), pressure drop at specified flow rate, spring range, positive positioner range, actuator size, close-off pressure data, dimensions, and access and clearance requirements data.

- e. A damper schedule showing each damper and actuator's identifier, nominal and actual sizes, orientation of axis and frame, direction of blade rotation, spring ranges, operation rate, positive positioner ranges, locations of actuators and damper end switches, arrangement of sections in multi-section dampers, and methods of connecting dampers, actuators, and linkages. The damper schedule shall include the maximum leakage rate at the operating static-pressure differential. The damper schedule shall contain actuator selection data supported by calculations of the torque required to move and seal the dampers, access and clearance requirements.

f. An HVAC control system equipment schedule showing the control loop, device unique identifier, device function, setpoint, input range, and additional important parameters (i.e. output range).

g. An HVAC control system sequence of operation.

h. An HVAC control system ladder diagram showing all relays, contacts, pilot lights, switches, fuses and starters connected to the control system.

i. HVAC control panel arrangement drawings showing both side and front views of the panel. The drawing shall show panel and mounting dimensions.

j. HVAC control panel cross-section drawings showing mounting rails and standoffs for devices.

k. HVAC control panel inner door layout drawings showing both front and rear views of the inner door. The drawings shall show device locations, labels, nameplate legends, and fabrication details.

l. HVAC control panel back-panel layout drawings showing device locations, labels, nameplate legends, terminal block layout, fabrication details, and enclosure operating temperature-rise calculations.

m. HVAC control system wiring diagrams showing functional wiring diagrams of the interconnection of conductors and cables to HVAC control panel terminal blocks and to the identified terminals of devices, starters and package equipment. The wiring diagrams shall show all necessary jumpers and ground connections. The wiring diagrams shall show the labels of all conductors. Sources of power required for HVAC control systems and for packaged-equipment control systems shall be identified back to the panel-board circuit breaker number, HVAC system control panel, magnetic starter, or packaged equipment control circuit. Each power supply and transformer not integral to a controller, starter, or packaged equipment shall be shown. The connected volt-ampere load and the power supply volt-ampere rating shall be shown.

#### SD-08 Statements

#### Commissioning Procedures; FIO

a. Six copies of the HVAC control system commissioning procedures, in indexed booklet form, 60 days prior to the scheduled start of commissioning. Commissioning procedures shall be provided for each HVAC control system, and for each type of terminal-unit control system. The commissioning procedures shall reflect the format and language of this specification, and refer to devices by their unique identifiers as shown. The commissioning procedures shall be specific for each HVAC system, and shall give detailed step-by-step procedures for commissioning of the system.

b. Commissioning procedures documenting detailed, product-specific set-up procedures, configuration procedures, adjustment procedures, and calibration procedures for each device. Where the detailed product-specific commissioning procedures are included in manufacturer supplied manuals, reference may be made in the HVAC control system commissioning procedures to the manuals.

c. Commissioning procedures documenting controller configuration check sheets for each controller listing all configuration parameters, dip switch and jumper settings, and initial recommended P, I and D values. The configuration parameters shall be listed in the order in which they appear during the configuration process. Each configuration parameter shall be noted as being: set per specs with no field adjustment required, set per specs but field adjustable, or not applicable.

d. Commissioning procedures showing a time clock configuration checksheet listing all parameters, and switch settings. The parameters shall be listed in the order which they appear during the setup process.

e. An HVAC control system commissioning procedures equipment list that lists the equipment to be used to accomplish commissioning. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

#### Performance Verification Test Procedures;

Six copies of the HVAC control system performance verification test procedures, in indexed booklet form, 60 days before the Contractor's scheduled test dates. The performance verification test procedures shall refer to the devices by their unique identifiers as shown, shall explain, step-by-step, the actions and expected results that will demonstrate that the HVAC control system performs in accordance with the sequences of operation. An HVAC control system performance verification test equipment list shall be included that lists the equipment to be used during performance verification testing. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

#### Training Course Materials;

Six copies of HVAC control system training course material 30 days prior to the scheduled start of the training course. The training course material shall include the operation manual, maintenance and repair manual, and paper copies of overheads used in the course. An HVAC control system training course, in outline form, with a proposed time schedule. Approval of the planned training schedule shall be obtained from the Government at least 60 days prior to the start of the training.

#### SD-09 Reports

##### Commissioning Report; FIO

Six copies of the HVAC control system commissioning report, in indexed booklet form, within 30 days after completion of the system commissioning. The commissioning report shall include data collected during the HVAC control system commissioning and shall follow the format of the commissioning procedures. The commissioning report shall include all controller and time clock checksheets with final values listed for all parameters, setpoints, P, I, D setting constants, calibration data for all devices, and results of adjustments.

##### Performance Verification Test Report; FIO

Six copies of the HVAC control system performance verification test report, in indexed booklet form, within 30 days after completion of the test. The HVAC control system performance verification test report shall include data collected during the HVAC control system performance verification test. The original copies of data gathered during the performance verification test shall be turned over to the Government after Government approval of the test results.

#### SD-13 Certificates

##### ASME Air-Storage Tank Certificate;

An ASME Air-Storage Tank Certificate for each storage tank.

#### SD-18 Records

## Service Organizations; FIO

Six copies of a list of service organizations qualified to service the HVAC control system. The list shall include the service organization name, address, technical point of contact and telephone number, and contractual point of contact and telephone number.

## SD-19 Operation and Maintenance Manuals

### Operation Manual;

### Maintenance and Repair Manual;

Six copies of the HVAC control system operation manual and HVAC control system maintenance and repair manual for each HVAC control system 30 days before the date scheduled for the training course.

## 1.4 DELIVERY AND STORAGE

Products shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants, within the storage-condition limits published by the equipment manufacturer. Dampers shall be stored so that seal integrity, blade alignment and frame alignment are maintained.

## 1.5 OPERATION MANUAL

An HVAC control system operation manual for each HVAC control system, in indexed booklet form, shall be provided. The operation manual shall include the HVAC control system sequence of operation, and procedures for the HVAC system start-up, operation and shut-down. The operation manual shall include as-built HVAC control system detail drawings. The operation manual shall include the as-built controller configuration checksheets, the as-built time clock configuration checksheet, the HVAC control system front panel description, the procedures for changing HVAC system controller setpoints, the procedures for gaining manual control of processes, the time clock manufacturer's manual control of processes, the time clock manufacturer's operation manual, and the controller manufacturer's operation manual.

a. The HVAC control system front panel description shall explain the meaning and use of the lights, switches, gauges, and controller displays located in the front panel. Each light, switch, gauge, and display described shall be numbered and referenced to a drawing of the front panel.

b. The procedures for changing HVAC system controller setpoints shall describe the step-by-step procedures required to change: the process variable setpoints of controllers, the alarm setpoints of controllers, the controller bias settings, and controller setpoint reset schedules.

c. The procedures for gaining manual control of processes shall describe step-by-step procedures required to gain manual control of devices and manually adjust their positions.

## 1.6 MAINTENANCE AND REPAIR MANUAL

An HVAC control system maintenance and repair manual for each HVAC control system, in indexed booklet form in hardback binders, shall be provided. The maintenance and repair manual shall include the routine maintenance checklist, a recommended repair methods list, a list of recommended maintenance and repair tools, the qualified service organization list, the as-built commissioning procedures and report, the as-built performance verification test procedures and report, and the as-built equipment data booklet (EDB).

a. The routine maintenance checklist shall be arranged in a columnar format. The first column shall list all devices listed in the equipment compliance booklet (ECB), the second column shall state the maintenance activity or state no maintenance required, the third column shall state the frequency of the maintenance activity, and the fourth column for additional comments or reference.

b. The recommended repair methods list shall be arranged in a columnar format and shall list all devices in the equipment compliance booklet (ECB) and state the guidance on recommended repair methods, either field repair, factory repair, or whole-item replacement.

c. The as-built equipment data booklet (EDB) shall include the equipment compliance booklet (ECB) and all manufacturer supplied user manuals and information.

d. If the operation manual and the maintenance and repair manual are provided in a common volume, they shall be clearly differentiated and separately indexed.

## PART 2 PRODUCTS

### 2.1 MATERIAL AND EQUIPMENT

Material and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization. The Contractor shall submit a certified list of qualified permanent service organizations and qualifications. These service organizations shall be reasonably convenient to the equipment on a regular and emergency basis during the warranty period.

### 2.2 GENERAL EQUIPMENT REQUIREMENTS

#### 2.2.1 Electrical and Electronic Devices

All electrical and electronic devices not located within an HVAC control panel shall have a NEMA Type 1 enclosure in accordance with NEMA 250 unless otherwise shown.

#### 2.2.2 Standard Signals

The output of all analog transmitters and the analog input and output of all single-loop controllers and function modules shall be 4-to-20 mAdc signals. The signal shall originate from current-sourcing devices and shall be received by current-sinking devices.

#### 2.2.3 Ambient Temperature Limits

Ambient Temperature Actuators and positive positioners, and transmitters shall operate within temperature limit ratings of 40 to 140 degrees F. All panel-mounted instruments shall operate within limit ratings of 35 to 120 degrees F and 10 percent to 95 percent relative humidity, noncondensing. All devices

installed outdoors shall operate within limit ratings of minus 40 to plus 150 degrees F.

#### 2.2.4 Nameplates, Lens Caps, and Tag Nameplates

Nameplates, lens caps, and lens caps bearing legends as shown and tags bearing device-unique identifiers as shown shall have engraved or stamped characters. A plastic or metal tag shall be mechanically attached directly to each device or attached by a metal chain or wire. Each air flow measurement station shall have a tag showing flow rate range for signal output range, duct size, and identifier as shown.

### 2.3 MATERIALS

#### 2.3.1 NOT USED

#### 2.3.2 Wiring

##### 2.3.2.1 Terminal Blocks

Terminal blocks shall be insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, shall be suitable for rail mounting, and shall have end plates and partition plates for separation or shall have enclosed sides.

##### 2.3.2.2 Control Wiring for 24-Volt Circuits

Control wiring for 24-volt circuits shall be 18 AWG minimum, stranded copper and shall be rated for 300-volt service.

##### 2.3.2.3 Wiring for 120-Volt Circuits

Wiring for 120-volt circuits shall be 18 AWG minimum, stranded copper and shall be rated for 600-volt service.

##### 2.3.2.4 Analog Signal Wiring Circuits

Analog signal wiring circuits within control panels shall not be less than 20 AWG and shall be rated for 300-volt service.

##### 2.3.2.5 Instrumentation Cable

Instrumentation cable shall be 18 AWG, stranded copper, single or multiple-twisted, minimum 2 inch lay of twist, 100 percent shielded pairs, and shall have a 300-volt insulation. Each pair shall have a 20 AWG tinned-copper drain wire and individual overall pair insulation. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned-copper cable drain wire, and overall cable insulation.

##### 2.3.2.6 Nonconducting Wiring Duct

Nonconducting wiring duct in control panels shall have wiring duct in control panels shall have slotted sides, snap-on duct covers, have slotted sides, snap-on duct covers, fittings for connecting ducts, mounting clips for securing ducts, and wire-retaining clips.

##### 2.3.2.7 Transformers

Step-down transformers shall be utilized where control equipment operates at lower than line circuit voltage. Transformers, other than transformers in

bridge circuits, shall have primaries wound for the voltage available and secondaries wound for the correct control circuit voltage. Transformers shall be sized so that the connected load is 80 percent of the rated capacity or less. Transformers shall conform to UL 508.

## 2.4 ACTUATORS

Actuators shall be electric or electronic as shown and shall be provided with mounting and connecting hardware. Actuators shall fail to their spring-return positions on signal or power failure. The actuator stroke shall be limited in the direction of power stroke by an adjustable stop. Actuators shall have a visible position indicator. Actuators shall smoothly open or close the devices to which they are applied and shall have a full stroke response time of 60 seconds or less. Electric or electronic actuators operating in series shall have an auxiliary actuator driver. Electric actuators shall have an oil-immersed gear train. Electric actuators used in a sequencing application shall have zero and span adjustments.

### 2.4.1 Valve Actuators

Valve actuators shall be selected to provide a minimum of 125 percent of the motive power necessary to operate the valve over its full range of operation.

### 2.4.2 NOT USED

## 2.5 AUTOMATIC CONTROL VALVES

### 2.5.1 Valve Assembly

Valves shall have stainless-steel stems and stuffing boxes with extended necks to clear the piping insulation. Unless otherwise stated, valves shall have globe style bodies. Valve bodies shall be designed for not less than 125 psig working pressure or 150 percent of the system operating pressure, whichever is greater. Valve leakage rating shall be 0.01 percent of rated Cv.

### 2.5.2 NOT USED

### 2.5.3 Two-Way Valves

Two-way modulating valves shall have equal-percentage characteristics.

### 2.5.4 Three-Way Valves

Three-way valves shall provide linear flow control with constant total flow throughout full plug travel.

### 2.5.5 NOT USED

### 2.5.6 NOT USED

### 2.5.7 Valves for Hot-Water Service

Valves for hot-water service below 250 Degrees F shall be as follows: Bodies for valves 1-1/2 inches and smaller shall be brass or bronze, with threaded or union ends. Bodies for 2 inch valves shall have threaded ends. Bodies for valves from 2 to 3 inches inclusive shall be of brass, bronze, or iron. Bodies for valves 4 inches and larger shall be iron. Bodies for valves 2-1/2 inches and larger shall be provided with flanged-end connections. Valve Cv shall be within 100 percent to 125 percent of the Cv shown. Internal trim (including seats, seat rings, modulating plugs, and springs) of valves controlling water hotter than 210 degrees F shall be Type 316 stainless steel. Internal trim for valves controlling water 210 degrees F or less shall be



brass or bronze. Nonmetallic parts of hot-water control valves shall be suitable for a minimum continuous operating temperature of 250 degrees F or 50 degrees F above the system design temperature, whichever is higher. Valves 4 inches or larger shall be butterfly valves.

2.5.8 NOT USED

2.5.9 NOT USED

## 2.6 DAMPERS

### 2.6.1 Damper Assembly

A single damper section shall have blades no longer than 48 inches and shall be no higher than 72 inches. Maximum damper blade width shall be 8 inches. Larger sizes shall be made from a combination of sections. Dampers shall be steel, or other materials where shown. Flat blades shall be made rigid by folding the edges. All blade-operating linkages shall be within the frame so that blade-connecting devices within the same damper section will not be located directly in the air stream. Damper axles shall be 0.5 inch (minimum) plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings. Pressure drop through dampers shall not exceed 0.04 inch water gauge at 1,000 fpm in the wide-open position. Frames shall not be less than 2 inches in width. Dampers shall be tested in accordance with AMCA 500.

#### 2.6.1.1 Operating Links

Operating links external to dampers (such as crankarms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers) shall withstand a load equal to at least twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Working parts of joints and clevises shall be brass, bronze, or stainless steel. Adjustments of crankarms shall control the open and closed positions of dampers.

#### 2.6.1.2 Damper Types

Dampers shall be parallel blade type.

### 2.6.2 Outside-Air, Return-Air, and Relief-Air Dampers

The dampers shall be provided where shown. Blades shall have interlocking edges and shall be provided with compressible seals at points of contact. The channel frames of the dampers shall be provided with jamb seals to minimize air leakage. Dampers shall not leak in excess of 20 cfm per square foot at 4 inches water gauge static pressure when closed. Seals shall be suitable for an operating temperature range of minus 40 to plus 200 degrees F. Dampers shall be rated at not less than 2000 fpm air velocity.

### 2.6.3 Mechanical and Electrical Space Ventilation Dampers

The dampers shall be as shown. Dampers shall not leak in excess of 80 cfm per square foot at 4 inches water (gauge) static pressure when closed. Dampers shall be rated at not less than 1500 fpm air velocity.

2.6.4 NOT USED

### 2.6.5 Damper End Switches

Each end switch shall be a hermetically-sealed switch with a trip lever and over-travel mechanism. The switch enclosure shall be suitable for mounting on the duct exterior and shall permit setting the position of the trip lever that actuates the switch. The trip lever shall be aligned with the damper blade.

## 2.7 DUCT SMOKE DETECTORS

Duct detectors are provided under Section C- 16721 Fire Detection and Alarm Systems.

## 2.8 INSTRUMENTATION

### 2.8.1 Measurements

Transmitters shall be factory calibrated to provide an output of 4 to 20 mAdc over the indicated ranges:

- a. Conditioned space temperature, from 50 to 85 degrees F.
- b. Duct temperature, from 40 to 140 degrees F except that return-air temperature for economizer operation shall be minus 30 to plus 130 degrees F.
- c. NOT USED
- d. NOT USED
- e. NOT USED
- f. Heating hot-water temperature, from 100 to 250 degrees F.
- g. NOT USED
- h. Outside-air temperature, from minus 30 to 130 degrees F.
- i. NOT USED
- j. NOT USED
- k. Pitot-tube air-flow measurement station and transmitter, from 0 to 0.1 inch water (gauge) for flow velocities of 700 to 1200 fpm, 0 to 0.25 inch water (gauge) for velocities of 700 to 1800 fpm, 0 to 0.5 inch water (gauge) for velocities of 700 to 2500 fpm.
- l. Electronic air-flow measurement station and transmitter, from 125 to 2500 fpm.

### 2.8.2 Temperature Instruments

#### 2.8.2.1 Resistance Temperature Detectors (RTD)

Temperature sensors shall be 100 ohms 3-RTD. Each RTD shall be platinum with a tolerance of plus or minus 0.1 percent at 32 degrees F, and shall be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper. Each RTD shall be furnished with an RTD transmitter as specified, integrally-mounted unless otherwise shown.

#### 2.8.2.2 Continuous-Averaging RTD

Continuous-averaging RTDs shall have a tolerance of plus or minus 1.0 degree F at the reference temperature, and shall be of sufficient length to ensure that the resistance represents an average over the cross-section in which it is installed. The sensing element shall have a bendable copper sheath. Each

averaging RTD shall be furnished with an RTD transmitter as specified, to match the resistance range of the averaging RTD.

#### 2.8.2.3 RTD Transmitter

The RTD transmitter shall accept a 3-wire 100 ohm RTD input. The transmitter shall be a 2-wire, loop-powered device. The transmitter shall produce a linear 4-to-20 mA<sub>dc</sub> output corresponding to the required temperature measurement. The output error shall not exceed 0.1 percent of the calibrated span. The transmitter shall include offset and span adjustments.

#### 2.8.3 NOT USED

#### 2.8.4 NOT USED

#### 2.8.5 NOT USED

#### 2.8.6 Differential Pressure Instruments

The instrument shall be a pressure transmitter with an integral sensing element. The instrument over pressure rating shall be 300 percent of the operating pressure. The sensor/transmitter assembly accuracy shall be plus or minus 2 percent of full scale. The transmitter shall be a 2-wire, loop-powered device. The transmitter shall produce a linear 4-to-20 mA<sub>dc</sub> output corresponding to the required pressure measurement. Each transmitter shall have offset and span adjustments.

#### 2.8.7 Thermowells

Thermowells shall be Series 300 stainless steel with threaded brass plug and chain, 2 inch lagging neck and extension-type well, and inside diameter and insertion length as required for the application.

#### 2.8.8 Sunshields

Sunshields for outside-air temperature sensing elements shall prevent the sun from directly striking the temperature sensing elements. The sunshields shall be provided with adequate ventilation so that the sensing element responds to the ambient temperature of the surroundings. The top of each sunshield shall have a galvanized-metal rainshield projecting over the face of the sunshield. The sunshields shall be painted white or shall be unpainted aluminum.

### 2.9 THERMOSTATS

Thermostat ranges shall be selected so that the setpoint is adjustable without tools between plus or minus 10 degrees F of the setpoint shown. Thermostats shall be electronic or electric.

#### 2.9.1 Nonmodulating Room Thermostats

Contacts shall be single-pole double-throw (SPDT), hermetically sealed, and wired to identified terminals. Maximum differential shall be 5 degrees F. Room thermostats shall be enclosed with separate locking covers (guards). Thermostats shall have manual switches as required by the application.

#### 2.9.2 Microprocessor-Based Room Thermostats

Microprocessor-based thermostats shall have built-in keypads for scheduling of day and night temperature settings. Access to the scheduling mode shall be by a password control code. When out of the scheduling mode, thermostats shall have continuous display of time, with AM and PM indicator, continuous display of day of week, and either continuous display of room temperature with display

of temperature setpoint on demand, or continuous display of temperature setpoint with display of room temperature on demand. In the programmable mode, the display shall be used for interrogating time program ON-OFF setpoints for all 7 days of the week. The time program shall allow 2 separate temperature-setback intervals per day. The thermostats shall have a means for temporary and manual override of the program schedule, with automatic program restoration on the following day. Thermostats shall have a replaceable battery to maintain the timing and maintain the schedule in memory for 1 year in the event of a power outage. Maximum differential shall be 2 degrees F. When used for heat-pump applications, the thermostat shall have an emergency heat switch.

#### 2.9.3 Modulating Room Thermostats

Modulating room thermostats shall have either one output signal, two output signals operating in unison, or two output signals operating in sequence, as required for the application. Each thermostat shall have an adjustable throttling range of 4 to 8 degrees F for each output. Room thermostats shall be enclosed with separate locking covers (guards).

#### 2.9.4 Nonmodulating Capillary Thermostats and Aquastats

Each thermostat shall have a capillary length of at least 5 feet, shall have adjustable direct-reading scales for both setpoint and differential, and shall have a differential adjustable from 3 to 9 degrees C. 6 to 16 degrees F. Aquastats shall be of the strap-on type, with 5 degrees C 10 degrees F fixed differential.

#### 2.9.5 Low-Temperature-Protection Thermostats

Low-temperature-protection thermostats shall be, low-temperature safety thermostats, with NO and NC contacts with an element length of 20 feet, which shall respond to the coldest 18 inch segment.

#### 2.9.6 Modulating Capillary Thermostats

Each thermostat shall have either one output signal, two output signals operating in unison, or two output signals operating in sequence, as required for the application. Thermostats shall have adjustable throttling ranges of 4 to 8 degrees F for each output.

#### 2.9.7 NOT USED

### 2.10 PRESSURE SWITCHES

#### 2.10.1 Pressure Switches

Each switch shall have an adjustable setpoint with visible setpoint scale. Range shall be as shown. Differential adjustment shall span 20 to 40 percent of the range of the device.

#### 2.10.2 Differential-Pressure Switches

Each switch shall be an adjustable diaphragm-operated device with two SPDT contacts, with taps for sensing lines to be connected to duct pressure fittings designed to sense air pressure. These fittings shall be of the angled-tip type with tips pointing into the air stream. The setpoint shall not be in the upper or lower quarters of the range and the range shall not be more than three times the setpoint. Differential shall be a maximum of 0.15 inch water gauge at the low end of the range and 0.35 inch water gauge at the high end of the range.

2.10.3 NOT USED

2.10.4 NOT USED

2.11.1 Thermometers

2.11.1.1 Piping System Thermometers

Piping system thermometers shall have brass, malleable iron or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 9 inch scale. Thermometers for piping systems shall have rigid stems with straight, angular, or inclined pattern.

2.11.1.2 Piping System Thermometer Stems

Thermometer stems shall have expansion heads as required to prevent breakage at extreme temperatures. On rigid-stem thermometers, the space between bulb and stem shall be filled with a heat-transfer medium.

2.11.1.3 Non-Averaging Air-Duct Thermometers

Air-duct thermometers shall have perforated stem guards and 45-degree adjustable duct flanges with locking mechanism.

2.11.1.4 Averaging Air-Duct Thermometers

Averaging thermometers shall have a 3-1/2 inch (nominal) dial, with black legend on white background, and pointer traveling through a 270-degree arc.

2.11.1.5 Accuracy

Thermometers shall have an accuracy of plus or minus 1 percent of scale range. Thermometers shall have a range suitable for the application.

2.11.2 Pressure Gauges

Gauges shall be 2 inch (nominal) size, back connected, suitable for field or panel mounting as required, shall have black legend on white background, and shall have a pointer traveling through a 270-degree arc. Accuracy shall be plus or minus 3 percent of scale range. Gauges shall meet requirements of ASME B40.1.

2.11.2.1 NOT USED

2.11.2.2 NOT USED

2.11.2.3 Hydronic-System Gauges

Gauges for hydronic-system applications shall have ranges and graduations as shown.

2.11.2.4 NOT USED

2.11.3 Low Differential Pressure Gauges

Gauges for low differential-pressure measurements shall be a minimum of 3.5 inch (nominal) size with two sets of pressure taps, and shall have a diaphragm-actuated pointer, white dial with black figures, and pointer zero adjustment. Gauges shall have ranges and graduations as shown. Accuracy shall be plus or minus 2 percent of scale range.

## 2.12 SINGLE-LOOP CONTROLLERS

### 2.12.1 Controller Features

The controller shall be a microprocessor-based single-loop device that does not require Contractor generated software. The controller shall be mountable in a panel cutout measuring 3.62 by 3.62 inches. The controller shall have field scalable process variable, a remote setpoint analog input and an analog output with adjustable high and low end limits and proportional control manual reset adjustment. The analog output shall result from proportional, integral and derivative (PID) control. The analog output shall be configurable as direct acting and reverse acting. The controller shall have keyboard, display, auto/manual selection for control of its analog output, remote setpoint adjustment/local setpoint adjustment selection with adjustable high-end and low-end limits, ratio and bias adjustments on remote setpoint input, operator-initiated self-tune/manual-tune selection, anti-reset wind-up feature, and 2 independent SPDT contact-closure outputs (PV alarm and deviation alarm). The controller shall be configurable to power-up in automatic with local setpoint control and in automatic with remote setpoint control. The range of hysteresis adjustment shall be not smaller than from 1 percent to 5 percent of process variable input span. The controller shall power the analog output loop to 20 milliamperes when connected to a load of 600 ohms. The controller shall be capable of retransmitting the process variable to 20 milliamperes when connected to 600 ohms. The controller shall have 5-year battery backup to store operating parameters or shall have nonvolatile memory.

### 2.12.2 Parameter Input and Display

Control parameters shall be entered and displayed directly, in the correct engineering units, through a series of keystrokes on a front-panel display with a 3-1/2 digit, 7-segment display, with decimal point and polarity indication. The use of this display shall allow manual interrogation of setpoint, mode constants, and values of the process variable and output.

### 2.12.3 Controller Electrical Requirements

Each controller shall be powered by 120 volts ac. Power consumption shall not be greater than 25 watts. Each controller shall provide electrical noise isolation between the ac power line and the process variable input, remote setpoint input, and output signals and of not less than 100 db at 60 Hz common-mode rejection ratio, and not less than 60 db at 60 Hz normal-mode rejection ratio.

### 2.12.4 Controller Accuracy

The controller shall have an accuracy of plus or minus 0.30 percent of input span, plus or minus 1 digit.

### 2.12.5 Self-Tuning

The controller self-tuning operation shall apply proportional, integral, and derivative modes of control and shall modify the mode constants as required. Self-tuning shall only be in operation when selected from the front panel.

### 2.12.6 Manual-Tuning

The controller manual-tuning operation shall provide proportional, integral, and derivative control modes, or any combination thereof, by means of individual mode constant adjustments. These adjustments shall be set for the

appropriate value if a particular control mode action is desired, or to zero if that particular mode is not desired. The proportional-mode constant shall be adjustable from 0 to 200 percent of input signal range, the integral-mode constant shall be adjustable from 0 to 20 repeats per minute, and derivative-mode constant shall be adjustable from 0 to 5 minutes.

## 2.13 CONTROL DEVICES AND ACCESSORIES

Control device and accessory input impedance shall not exceed 250 ohms.

### 2.13.1 Function Modules

Function modules shall accept mAdc analog input signals to produce mAdc analog output signals or contact output signals. Modules shall have zero and span adjustments for analog outputs, and setpoint adjustments for contact outputs. Module output span accuracy shall be plus or minus 1 percent of input span. Modules shall be rail-mounted as shown. Power consumption shall be not greater than 5 watts.

#### 2.13.1.1 Minimum-Position Switch and Temperature-Setpoint Device

Minimum-position switch and temperature-setpoint device shall accept a 1000 ohms potentiometer input and shall produce a steady analog output. In temperature setpoint applications the potentiometer shall be single-turn, suitable for wall mounting, enclosed in a locking metal or heavy duty plastic enclosure and shall have a graduated dial corresponding to the range of the setpoint adjustment. In a minimum position switch application the potentiometer shall be mounted on or internal to the minimum position switch. The device shall have its input signal electrically or optically isolated from output. Mounting socket shall be an 8 pin base with pins 1, 2, 3 ac power input, 4, 5, 6 input signal, 7, 8, output signal.

#### 2.13.1.2 Signal-Inverter Modules

Signal inverter shall accept an analog input signal and shall have sufficient output capacity to drive the output signal through a circuit with an impedance of not less than 600 ohms. The output shall be electrically isolated from the input and the device shall have a moisture resistant coating. Mounting socket shall be an 8 pin base with pins 1, 2, 3 ac power input, 4, 5, 6 input signal, 7, 8, output signal.

#### 2.13.1.3 High-Low Signal Selector

High-low signal-selector modules shall accept analog input signals and select either the highest or the lowest input signal as the output signal. The signal selector shall be powered by 120 Vac and the output signal shall be electrically isolated from the input signal.

#### 2.13.1.4 Sequencer Modules (Dual Limit Alarm)

Sequencer modules (dual limit alarms) shall accept an analog input signal and shall provide two contact closure outputs. Each output shall have an adjustable independent contact setpoint with an adjustable switching differential range between 1 percent and 100 percent of the input span. The setpoint shall be adjustable between 0 percent and 100 percent of the input span. Setpoint and switching differential (deadband) adjustment potentiometers shall be internal, top-accessed potentiometers or screws. Sequencers shall return all contacts to their zero input signal condition when power is interrupted. The device shall have moisture resistant coating.

#### 2.13.1.5 Loop Driver Modules

Loop driver module shall accept an analog input signal and shall have a circuit input impedance not greater than 100 ohms. The loop driver module shall have sufficient output capacity to drive the output signal through a circuit with an impedance range of not less than 1000 ohms. The output shall be electrically isolated from the input and the device shall have moisture resistant coating. Mounting socket shall be an 8 pin base with pins 1, 2, 3 ac power input, 4, 5, 6 input signal, 7, 8 output signal.

#### 2.13.2 Relays

Relays shall be 2-pole, double-throw (2PDT) with a 10-ampere resistive rating at 120 Vac, and shall have an enclosed 120-Vac coil with 8 pin blade connectors, and a matching rail-mounted socket. Power consumption shall not be greater than 3 watts.

#### 2.13.3 Time-Delay Relays

Time delay relays shall be 2PDT with 8 pin connectors, dust cover, and a matching rail-mounted socket. Adjustable timing range shall be 0 to 5 minutes. Power consumption shall be not greater than 3 watts.

#### 2.13.4 Time Clocks

Each time clock shall be a 365-day programmable timing device with 4 independently timed circuits. Each clock shall have a manual scheduling keypad and an alphanumeric display of all timing parameters. Timing parameters shall include: date in Gregorian calendar for month, day and day-of-month indication; and 24-hour time-of-day display, with one-minute resolution for programming the ON and OFF times for each circuit. Each clock shall allow programming of each circuit for 12 holiday periods for either ON or OFF events for any selected duration of the 365-day program. Each clock shall have capacity for programming 4 ON events and 4 OFF events per day for each circuit. The programmed events shall be assignable to a 365-day schedule. Each clock shall have automatic Standard Time and Daylight Saving Time adjustment, by input of the appropriate dates. Each time clock shall have automatic leap year correction. Each clock shall be provided with 4-day battery backup. Power consumption shall not be greater than 10 watts.

#### 2.13.5 NOT USED

#### 2.13.6 Direct Current (DC) Power Supply

One DC power supply shall be used to power all transmitters connected to the control panel. The power supply shall be 24 Vdc at not less than 1.2 amperes, with a peak-to-peak ripple not to exceed 0.03 percent of output voltage. Each power supply shall have a fused input, and shall be protected from voltage surges and powerline transients. The power supply output shall be protected against overvoltage and short circuits.

#### 2.13.7 Power Line Conditioner (PLC)

PLCs shall be furnished for each controller panel. The PLCs shall provide both voltage regulation and noise rejection. The PLCs shall be of the ferro-resonant design, with no moving parts and no tap switching, while electrically isolating the secondary from the power line side. The PLCs shall be sized for 125 percent of the actual connected kva load. Characteristics of the PLC shall be as follows:

a. At 85 percent load, the output voltage shall not deviate by more than plus or minus 1 percent of nominal voltage when the input voltage fluctuates between minus 20 percent to plus 10 percent of nominal voltage.



b. During load changes of zero to full load, the output voltage shall not deviate by more than plus or minus 3 percent of nominal voltage. Full correction of load switching disturbances shall be accomplished within 5 cycles, and 95 percent correction shall be accomplished within 2 cycles of the onset of the disturbance.

c. Total harmonic distortion shall not exceed 3-1/2 percent at full load.

## 2.14 PILOT LIGHTS AND MANUAL SWITCHES

Pilot lights and switches shall be rectangular devices arranged in a horizontal matrix as shown. Momentary switches shall be non-illuminated. Interlocking switches shall have separately illuminated sections. Split legend lights shall have separately illuminated sections. Device illumination shall be by light-emitting diode or neon lamp.

## 2.15 HVAC SYSTEM CONTROL PANELS

### 2.15.1 Panel Assembly

The control panel shall be factory assembled and shipped to the job site as a single unit. The panel shall be fabricated as shown, and the devices shall be mounted as shown. Each panel shall be fabricated as a bottom-entry connection point for control-system electric power, control-system main air source, control-system wiring, pneumatic tubing, interconnection of control systems, interconnection of starters and external shutdown devices, and energy monitoring and control systems (EMCS) interface. Each panel shall have an operating temperature rise of not greater than 20 degrees F above an ambient temperature of 100 degrees F.

### 2.15.2 Panel Electrical Requirements

Each control panel shall be powered by nominal 120 volts ac, fused at 5 amps, terminating at the panel on terminal blocks. Instrument cases shall be grounded. Interior panel, interior door, and exterior panel enclosure shall be grounded.

Panel shall be built and installed in accordance with UL 1995. Provide label on panel stating 'CAUTION: HAZARD OF ELECTRICAL SHOCK. DISCONNECT THE REMOTE POWER SUPPLY BEFORE SERVICING.'

### 2.15.3 Enclosure

The enclosure for each panel shall be a NEMA 12 single-door wall-mounted box conforming to NEMA 250, with continuous hinged and gasketed exterior door with print pocket and key lock, continuous hinged interior door, interior back panel, and ventilation louvers in back surface as shown. Inside finish shall be white enamel, and outside finish shall be gray primer over phosphatized surfaces.

### 2.15.4 Mounting and Labeling

Controllers, pilot lights, and switches shall be mounted on the interior door as shown. Power conditioner, fuses and duplex outlet shall be mounted on the interior of the cabinet as shown. All other components housed in the panel shall be mounted on the interior back panel surface of the enclosure, behind the door on rails as shown. Controllers and gauges mounted on the front of the inner door shall be identified by a plastic or metal nameplate as shown that is mechanically attached to the panel. Function modules, relays, timeclocks, IP transducers, DC power supply, and other devices interior to the

panel shall be identified by a plastic or metal nameplate that is mechanically attached to the panel. The nameplate shall have the inscription as shown. Lettering shall be cut or stamped into the nameplate to a depth of not less than 1/64 inch, and shall show a contrasting color, produced by filling with enamel or lacquer or by the use of a laminated material. Painting of lettering directly on the surface of the interior door or panel is not permitted.

#### 2.15.5 Wiring and Tubing

##### 2.15.5.1 NOT USED

##### 2.15.5.2 Panel Wiring

Interconnections Wiring shall be installed in wiring ducts in such a way that devices can be added or replaced without disturbing wiring that is not affected by the change. Wiring to all devices shall have a 4 inch wiring loop in the horizontal wiring duct at each wiring connection. There shall be no wiring splices within the control panel. All interconnections required for power or signals shall be made on device terminals or panel terminal blocks, with not more than two wires connected to a terminal.

##### 2.15.5.3 Panel Terminal Blocks

Terminal blocks shall be arranged in groups as shown. Instrument signal grounds at the same ground reference level shall end at a grounding terminal for connection to a common ground point. Wiring-shield grounds at the same reference level shall end at a grounding terminal for connection to a common ground point. Grounding terminal blocks shall be identified by reference level.

##### 2.15.5.4 Wiring Identification

All wiring connected to controllers, time clocks and function modules shall be identified by function and polarity with full word identifiers, i.e., process variable input, remote setpoint input and control output.

##### 2.15.6 EMCS Terminal Blocks

Terminal blocks shall be provided for connections to EMCS as shown. Analog signals shall require only the removal of jumpers to interface to EMCS.

#### 2.16 NOT USED

#### 2.17 ELECTRONIC VARIABLE AIR VOLUME (VAV) TERMINAL UNIT CONTROLS

##### 2.17.1 VAV Terminal Units

The VAV terminal units shall be as specified in Section C-15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

##### 2.17.2 Terminal-Unit Controls

##### 2.17.2.1 Box Control Device

Controls for pressure independent boxes shall consist of a velocity-sensing device in the primary air entering the box, a room temperature sensing element, a damper actuator, and an adjustable microprocessor-based VAV box controller. Each controller shall operate a damper for cooling. Terminal unit controls shall meet the requirements of UL 916 and 47 CFR 15.

#### 2.17.2.2 Communication and Programming Device

One hand-held communication and programming device with instruction manual, plus one additional hand-held communicating device and instruction manual per 100 terminal units, shall be provided. The communication and programming device shall connect to the controller directly or to a jack at the room-temperature-sensing element location. The communication and programming device shall be used to read and set minimum velocity, maximum velocity, heating setpoint, and cooling setpoint, and to read velocity and space temperature.

### PART 3 EXECUTION

#### 3.1 GENERAL INSTALLATION CRITERIA

The HVAC control system shall be installed and ready for operation, as specified and shown. Dielectric isolation shall be provided where dissimilar metals are used for connection and support. Penetrations through and mounting holes in the building exterior shall be made watertight. The HVAC control system installation shall provide clearance for control system maintenance by maintaining access space between coils, access space to mixed-air plenums, and other access space required to calibrate, remove, repair, or replace control system devices. The control system installation shall not interfere with the clearance requirements for mechanical installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance.

##### 3.1.1 Device Mounting Criteria

Devices mounted in or on piping or ductwork, on building surfaces, in mechanical/electrical spaces, or in occupied space ceilings shall be installed in accordance with manufacturer's recommendations and as shown. Control devices to be installed in piping and ductwork shall be provided with all required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Strap-on temperature sensing elements shall not be used except as specified.

##### 3.1.2 Wiring Criteria

Wiring external to control panels, including low-voltage wiring, shall be installed in metallic raceways. Nonmetallic-sheathed cables or metallic-armored cables may be installed in areas permitted by NFPA 70. Wiring shall be installed without splices between control devices and HVAC control panels. Cables and conductors shall be tagged at both ends, with the identifier shown on the shop drawings, in accordance with the requirements of Section C-16415 ELECTRICAL WORK, INTERIOR. Other electrical work shall be as specified in Section C-16415 ELECTRICAL WORK, INTERIOR and as shown.

##### 3.1.2.1 Power-Line Surge Protection

Equipment connected to ac circuits shall be protected from powerline surges. Equipment protection shall meet the requirements of IEEE C62.41. Fuses shall not be used for surge protection.

##### 3.1.2.2 Surge Protection for Transmitter and Control Wiring

HVAC system control panel equipment shall be protected against surges induced on control and transmitter wiring installed outside and as shown. The

equipment protection shall be tested in the normal mode and in the common mode, using the following two waveforms:

a. A 10-microsecond by 1000-microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An 8-microsecond by 20-microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

#### 3.1.2.3 Controller Output Loop Impedance Limitation

Controller output loops shall be constructed so that total circuit impedance connected to the analog output of a single-loop controller shall not exceed 600 ohms.

### 3.2 CONTROL SYSTEM INSTALLATION

#### 3.2.1 Damper Actuators

Actuators shall not be mounted in the air stream. Multiple actuators operating a common damper shall be connected to a common drive shaft. Actuators shall be installed so that their action shall seal the damper to the extent required to maintain leakage at or below the specified rate and shall move the blades smoothly.

#### 3.2.2 NOT USED

#### 3.2.3 Room-Instrument Mounting

Room instruments shall be mounted so that their sensing elements are 5 feet above the finished floor unless otherwise shown. Temperature setpoint device shall be recess mounted.

#### 3.2.4 Smoke Detectors

Duct smoke detectors shall be provided in supply and return air ducts in accordance with NFPA 90A.

#### 3.2.5 Manual Emergency Fan Shutdown Switches

Manual emergency fan shutdown switches shall be provided for air distribution fans in accordance with NFPA 90A. Switches shall be the manual-reset type. Switches shall be located and mounted in an accessible manner, approximately 48 inches above the finished floor. Switches shall be properly identified in etched rigid plastic placards.

#### 3.2.6 Low-Temperature-Protection Thermostats

For each 20 square feet of coil-face area, or fraction thereof, a thermostat shall be provided to sense the temperature at the location shown. The thermostat sensing element shall be installed in a serpentine pattern.

#### 3.2.7 Averaging-Temperature Sensing Elements

Sensing elements shall have a total-element minimum length equal to one linear foot per square foot of duct cross-sectional area.

#### 3.2.8 NOT USED

#### 3.2.9 NOT USED

### 3.2.10 Duct Static-Pressure Sensing Elements and Transmitters

The duct static-pressure sensing element and transmitter sensing point shall be located at 75% to 100% of the distance between the first and last air terminal units.

### 3.2.11 Indication Devices Installed in Piping and Liquid Systems

Gauges in piping systems subject to pulsation shall have snubbers. Gauges for steam service shall have pigtail fittings with cock. Thermometers and temperature sensing elements installed in liquid systems shall be installed in thermowells.

### 3.2.12 NOT USED

## 3.3 CONTROL SEQUENCES OF OPERATION

### 3.3.1 System Requirements

These requirements shall apply to all primary HVAC systems unless modified herein. The sequences describe the actions of the control system for one direction of change in the HVAC process analog variable, such as temperature, humidity or pressure. The reverse sequence shall occur when the direction of change is reversed.

#### 3.3.1.1 HVAC System Supply Fan Operating

HVAC system outside-air, return-air, and relief-air dampers shall function as described hereinafter for specific modes of operation. Interlocked exhaust fans shall be stopped in the unoccupied and ventilation delay modes and their dampers shall be closed. Interlocked exhaust fans shall run in the occupied mode, and their dampers shall open. Heating coil valves shall be under control.

#### 3.3.1.2 HVAC System Supply Fan Not Operating

When an HVAC system is stopped, interlocked fans shall stop, the outside-air and relief-air dampers shall close, the return-air damper shall open, all stages of direct-expansion cooling shall stop, the system shall pump down if it has a pump down cycle, and cooling-coil valves for coils located indoors shall close to the coil. Heating-coil valves shall remain under control.

#### 3.3.1.3 HVAC System Hydronic Heating Distribution Pump Operation

Hydronic heat-exchanger valves shall be under control.

#### 3.3.1.4 HVAC System Hydronic Heating Distribution Pump Not Operating

Hydronic heat-exchanger valves shall close.

### 3.3.2 Convector

All Modes - A thermostatic self-contained control valve, located at each convector shall modulate to maintain the set point.

### 3.3.3 Electric Unit-Heater

All Modes - A wall-mounted thermostat with an "AUTO-OFF" switch and set point adjustment knob located as shown, shall cycle the fan and electric coil to maintain its setpoint as shown when the switch is in the "AUTO" position. When the switch is in the "OFF" position, the unit shall be off.

#### 3.3.4 Gas-Fired Infrared-Heater

A microprocessor-based room thermostat with "AUTO-OFF" switch, located as shown, shall control the infrared heater. When the switch is in the "AUTO" position, the thermostat shall cycle the infrared heater to maintain the day and night setpoints as shown. Programmed occupied times shall be considered "day" and programmed unoccupied times shall be considered "night." When the switch is in the "OFF" position, the infrared heater shall be off.

#### 3.3.5 NOT USED

#### 3.3.6 NOT USED

#### 3.3.7 NOT USED

#### 3.3.8 Single Building Hydronic Heating with Hot Water Boiler

a. All Modes - The outside-air temperature controller shall accept a signal at its process variable input from a sunshielded outside-air temperature sensing element and transmitter located as shown. The outside-air temperature controller process variable relay contact output shall start and stop the distribution pump CP-1, boiler pump BP-1 and boiler B-1 at the outside-air temperatures shown. The analog output of the outside-air temperature controller shall send a signal to the remote setpoint input of the primary hydronic-heating system temperature controller to reset the hydronic-heating supply temperature setpoint in a linear schedule based on the outside-air temperature as shown. The hydronic-heating supply temperature controller shall accept a signal at its process variable input from a temperature sensing element and transmitter located in the hydronic-heating supply line and the controller output shall modulate the hydronic-heating system control valve to maintain the reset schedule setpoint in the hydronic-heating supply line.

#### 3.3.9 NOT USED

#### 3.3.10 NOT USED

#### 3.3.11 NOT USED

#### 3.3.12 NOT USED

#### 3.3.13 Repair Bay Ventilation System (MAU, VEF, and EF)

##### 3.3.13.1 General

Each repair bay shall operate as a system. Whenever the Make-up Air Unit (MAU) fan is operating, the Vehicle Exhaust Fans (VEF) and where applicable pit Exhaust Fan (EF) shall also operate.

##### 3.3.13.2 MAU Supply-Fan Control

The supply fan shall be manually controlled by an "ON - OFF" switch in the MAU control panel. On Mode: Supply Fan shall start, and shall operate continuously. Off Mode: The supply fan shall be off.

##### 3.3.13.3 Outside-Air Damper

On Mode - the outside-air damper shall be open. Off Mode - The damper shall return to its normal position.

##### 3.3.13.4 Filter

A differential-pressure switch across the filter shall turn on the filter pilot light at the MAU control panel.

#### 3.3.13.5 Low-Temperature-Protection Thermostat

All Modes - A thermostat in the leaving-air side of the burner shall disable the supply fan and shall turn on the low-temperature pilot light at the MAU control panel. Restarting the fan and turning off the pilot light shall require manual reset at the control panel.

#### 3.3.13.6 Burner Control

On Mode - Supply air temperature sensing thermostat shall modulate the burner gas valve to maintain discharge temperature. An outside air sensing thermostat shall prevent the burner from operating if the ambient temperature exceeds the discharge temperature set point. Off Mode - the burner shall be disabled.

3.3.14 NOT USED

3.3.15 NOT USED

3.3.16 NOT USED

3.3.17 NOT USED

3.3.18 NOT USED

3.3.19 NOT USED

3.3.20 NOT USED

3.3.21 NOT USED

#### 3.3.22 Single-Zone - Hydronic Heating and Direct-Expansion Cooling Coils With Return Fan

##### 3.3.22.1 Occupied, Unoccupied, and Ventilation-Delay Modes

Ventilation-delay mode timing shall start prior to the occupied-mode timing. The timeclock shall close a contact, which shall turn on the ventilation-delay pilot light and energize a relay which shall prevent the outside-air damper from opening. At the time shown, the timeclock shall close a contact which shall turn on the occupied-mode pilot light and shall place the system in the occupied mode. At the expiration of the ventilation-delay-mode timing period, the timeclock shall open the contact to turn off the ventilation-delay mode pilot light and de-energize a relay to allow the outside-air damper to open. At the time shown, the timeclock shall open the contact to turn off the occupied-mode pilot light and shall place the control system in the unoccupied mode of operation.

##### 3.3.22.2 Outside-Air, Return-Air, and Relief-Air Dampers

a. Occupied Mode - The outside-air, return-air, and relief-air dampers shall be under mixed-air temperature and economizer control.

b. Unoccupied and Ventilation-Delay Modes - The dampers shall return to their normal positions as shown.

#### 3.3.22.3 Supply-Fan Control

a. Occupied and Ventilation-Delay Modes - Supply fan AHV-1, Return Fan RF-1 and Exhaust Fans EF-2 and EF-3 shall start, and shall operate continuously.

b. Unoccupied Mode - The supply fan and return fan shall cycle from a night-thermostat. The fans shall start at and stop at the setpoints as shown.

#### 3.3.22.4 Filter

A differential-pressure switch across the filter shall turn on the filter pilot light when the pressure drop across the filter reaches the setpoint as shown.

#### 3.3.22.5 Freeze Protection

All Modes - A freezestat, located as shown, shall stop the supply fan, cause the outside air, return air, and relief air dampers to return to their normal position as shown, and shall turn on the low-temperature pilot light in the HVAC control panel if the temperature drops below the freezestat's setpoint as shown. Return to the normal mode of operation shall require manual reset at the freezestat and at the HVAC control panel.

#### 3.3.22.6 Direct Expansion Cooling Coil

a. Occupied and Ventilation-Delay Modes - The stages of cooling shall be operated by the space-temperature controller.

b. Unoccupied Mode - The space-temperature controller output signal shall be interrupted and cooling shall be off.

#### 3.3.22.7 Economizer Control

An economizer controller shall accept the signal of an outside-air temperature-sensing element and transmitter at its remote setpoint input and shall accept the signal of a return-air temperature-sensing element and transmitter at its process variable input. The economizer controller shall perform switchover between outside-air economizer control mode and minimum-outside-air mode. Until the return-air temperature rises above the setpoint as shown, the economizer controller shall hold the system in the minimum-outside-air mode and the economizer pilot light shall be off. When the return-air temperature rises above the setpoint, the economizer controller shall place the control system in the economizer mode or in the minimum-outside-air mode as determined by a comparison of the outside-air and return-air temperatures in accordance with the differential temperature setpoints as shown. When the outside-air temperature is low with respect to the return-air temperature, the control system shall be in the economizer mode and the economizer pilot light shall be on. When the economizer controller places the control system in the minimum-outside-air mode, the outside-air damper shall be open to the setting determined by the minimum-position switch.

#### 3.3.22.8 Space-Temperature-Sequenced Heating and Cooling Control

A space-temperature sensing element and transmitter operating through a space-temperature controller shall maintain the setpoint by sequencing the heating coil valve, dampers, and stages of DX cooling as shown. On a rise in space temperature, the controller shall first gradually close the heating-coil valve. After the controller output passes through a deadband, the controller shall then gradually operate the outside-air damper to admit outside air beyond the minimum quantity, except that when the economizer controller places the system in the minimum-outside-air mode, the outside-air damper shall be



open to the setting as determined by the minimum-position switch. After the outside-air damper is fully open, upon a further rise in space temperature, the controller shall then operate the stages of cooling in sequence to maintain the setpoint as shown.

#### 3.3.22.9 Emergency Fan Shutdown

Activation of a duct smoke detector in the supply-air or return-air ductwork, or activation of a manual emergency fan shutdown switch shall cause the associated fan to shutdown in accordance with NFPA 90A. Activation of these devices shall operate a pilot light on the HVAC control panel. The panel shall require manual resetting after the detector and the manual switch are reset.

#### 3.3.22.10 Pressure-Independent Terminal Bypass VAV Box with Velocity (Bldg. B and C, Rm. 201 only)

All Modes - The control damper of the bypass VAV box shall modulate in response to the signal from a flow-sensing element at the discharge or inlet of the VAV box to a microprocessor-based VAV-box velocity controller. The velocity controller shall control the box damper from the minimum-flow position to the full-flow position from the signal of a space-temperature sensing element located as shown. When the space temperature decreases, the damper shall gradually close to the minimum-flow position to maintain the cooling setpoint as shown.

#### 3.3.23 TOOL ROOM HEAT RELIEF VENTILATION SYSTEM

3.3.23.1 Fan Control: A space thermostat shall control supply and exhaust fan operation through the respective motor starter. The fans shall operate when the space temperature rises above the setpoint indicated. The fans shall stop when the temperature falls below the differential of the thermostat as shown.

3.3.23.2 Dampers: The dampers associated with the fans shall be open whenever the fans are operating. When the fans are off the dampers shall be closed.

#### 3.3.24 MECHANICAL ROOM VENTILATION SYSTEM

3.3.24.1 Fan Control (Supply or Exhaust as indicated): The two speed fan shall be energized by a space thermostat. The fan shall operate when the space temperature rises above the thermostat set point indicated. The fan shall stop when the space temperature falls below the differential of the thermostat as indicated. The fan speed shall be selected from a wall mounted "summer-winter" push button station. In the "summer" position the fan shall operate in the high speed. IN the "winter" position the fan shall operate in low speed.

3.3.24.2 Damper Control (Relief or Intake as indicated): Fan Off Mode - The damper shall be closed. Fan On Mode - the damper shall be opened.

#### 3.3.25 SMB POL ROOM AND STORAGE ROOM VENTILATION SYSTEM

3.3.25.1 Exhaust Fan and Intake Damper Control: The fan shall be controlled by a high limit space thermostat and intake damper. The fan shall operate and the damper shall be open when the space temperature rises above the setpoint indicated for the high limit thermostat. When the space temperature is below this setpoint the fan shall be off and the damper shall be closed.

#### 3.4 COMMISSIONING PROCEDURES

### 3.4.1 General Procedures

#### 3.4.1.1 Evaluations

The Contractor shall make the observations, adjustments, calibrations, measurements, and tests of the control systems, tune the controllers, set the timeclock schedule, and make any necessary control-system corrections to ensure that the systems function as described in paragraph CONTROL SEQUENCES OF OPERATION. The Contractor shall permanently record, on system equipment schedule, the final setting of controller proportional, integral and derivative constant settings, setpoint, manual reset setting, maximum and minimum controller output, and ratio and bias settings, in units and terminology specific to the controller.

#### 3.4.1.2 Item Check

An item-by-item check of the sequence of operation requirement shall be performed using Steps 1 through 4 in the specified control system commissioning procedures. Steps 1, 2, and 3 shall be performed with the HVAC system shutdown; Step 4 shall be performed after the HVAC systems have been started. Signals used to change the mode of operation shall originate from the actual HVAC control device intended for the purpose, such as the time clock. External input signals to the HVAC control panel (such as EMCS, starter auxiliary contacts, and external systems) may be simulated in Steps 1, 2, and 3. With each operational-mode change signal, pilot lights and HVAC-panel output-relay contacts shall be observed to ensure that they function. All terminals assigned to EMCS shall be checked and observed to ensure that the proper signals are available.

#### 3.4.1.3 Weather-Dependent Test Procedures

Weather-dependent test procedures that cannot be performed by simulation shall be performed in the appropriate climatic season. When simulation is used, the Contractor shall verify the actual results in the appropriate season.

#### 3.4.1.4 Configuration

The Contractor shall configure each controller for its specified service.

#### 3.4.1.5 Two-Point Accuracy Check

A two-point accuracy check of the calibration of each HVAC-control-system sensing element and transmitter shall be performed by comparing the HVAC-control-panel readout to the actual value of the variable measured at the sensing element and transmitter or airflow measurement station location. Digital indicating test instruments shall be used, such as digital thermometers, motor-driven psychrometers, and tachometers. The test instruments shall be at least twice as accurate as the specified sensing element-to-controller readout accuracy. The calibration of the test instruments shall be traceable to NIST standards. The first check point shall be with the HVAC system in the shutdown condition, and the second check point shall be with the HVAC system in an operational condition. Calibration checks shall verify that the sensing element-to-controller readout accuracies at two points are within the specified product accuracy tolerances. If not, the device shall be recalibrated or replaced and the calibration check repeated.

#### 3.4.1.6 Insertion, Immersion Temperature

Insertion-temperature and immersion-temperature sensing element and transmitter-to-controller readout calibration accuracy shall be checked at one physical location along the axis of the sensing element.

#### 3.4.1.7 Averaging Temperature

Averaging-temperature sensing element and transmitter-to-controller readout calibration accuracy shall be checked every 2 feet along the axis of the sensing element in the proximity of the sensing element, for a maximum of 10 readings. These readings shall then be averaged.

#### 3.4.1.8 Controller Stations

The Contractor shall use the controllers' MANUAL/AUTOMATIC stations as the means of manipulating control devices, such as dampers and valves, to check IP operation and to effect stable conditions prior to making measurement checks.

#### 3.4.1.9 Controller-Tuning Procedure

The Contractor shall perform a controller-tuning procedure, which shall consist of setting the initial proportional, integral, and derivative (PID) mode constants, controller setpoints, and logging the settings. Tuning shall be self-tuning operation by the controller unless manual tuning is necessary.

#### 3.4.1.10 Controller Manual-Tuning Procedure

Where required, the controller manual-tuning procedure shall be performed in three steps. Using a constant-temperature-setpoint controller as an example, these steps are:

##### a. Step A:

- (1) The controller MANUAL/AUTO station shall be indexed to the AUTO position and the integral- and derivative-mode constants set to zero.
- (2) The proportional-mode constant shall be set to an initial setting of 8 percent. (This corresponds to 1.5 psig per degree F or 2.0 ma per degree F proportional controller output change for a 100 degree F transmitter span.) This causes the controller output signal to vary from live zero output to full output for an input signal change representing an 8 degree F change.
- (3) Controllers for other variables, such as relative humidity and static pressure, shall have their proportional-mode constants set initially in a similar manner for an achievable output range proportional to the transmitter span.

##### b. Step B:

- (1) The controller temperature setpoint shall be set at any achievable temperature. The controller output and transmitter input shall be observed.
- (2) If the transmitter input continuously oscillates above and below the setpoint without settling at a fixed value, or if such oscillation increases, the proportional-mode constant is too small.
- (3) If the proportional-mode constant is too small, increase it in steps until the transmitter input indicates stable control at any temperature, provided that the controller output is not at either extreme of the output range.
- (4) If the temperature control point slowly drifts toward or away from the controller setpoint, the proportional-mode constant is too large. Its setting shall be decreased in steps until oscillations occur as described in the preceding paragraphs, and then the setting shall be increased until stable control occurs.

(5) A step change in controller setpoint shall be introduced. This should cause the controller to overshoot the setpoint slightly, with each subsequent overshoot peak value decreasing by a factor of 2/3 until stable control is achieved at, above, or below the setpoint.

(6) Next, the integral-mode constant setting shall be increased in small steps, and setpoint changes shall be introduced until control point and controller setpoint coincide at stable control. This should happen consistently after a setpoint change within a short time, such as 5 to 10 minutes.

c. Step C:

(1) Unless the HVAC process variable changes rapidly, the derivative-mode constant setting can remain at zero.

(2) If derivative control is needed, the derivative-mode constant shall be gradually increased.

(3) Step changes in controller setpoint shall be introduced, and the derivative-mode constant setting adjusted until stable control is achieved.

#### 3.4.1.11 Setting the Controller

After the controller manual-tuning procedure is complete, the controller shall be set at the setpoint as shown.

#### 3.4.2 Space-Temperature-Controlled Connector

The heating medium shall be turned on, and the temperature setpoint shall be raised. The valve shall open. The temperature set point shall be lowered and the valve shall close. The thermostat shall be set at the setpoint shown.

#### 3.4.3 Electric Unit Heater

The "OFF/AUTO" switch shall be placed in the "OFF" position. Each space-thermostat temperature setting shall be turned up so that it makes contact to turn on the unit-heater fans. The unit-heater fans shall not start. The "OFF/AUTO" switch shall be placed in the "AUTO" position. The unit-heater fans shall start. Each space-thermostat temperature setting shall be turned down, and the unit-heater fans shall stop. The thermostats shall be set at their temperature setpoints as shown. The results of testing of one of each type of unit shall be logged.

#### 3.4.4 Gas-Fired Infrared-Heater

Each space-thermostat temperature setting shall be turned up so that it makes contact to turn on the infrared heaters controllers; the heater shall turn on. Each space-thermostat temperature shall be turned down and the infrared heaters shall turn off. The thermostats shall be set at their temperature setpoints as shown. The results of testing of one of each type of unit shall be logged.

#### 3.4.5 NOT USED

#### 3.4.6 NOT USED

#### 3.4.7 NOT USED

#### 3.4.8 Single Building Hydronic-Heating with Hot Water Boiler

Steps for installation shall be as follows:

a. Step 1 - System Inspection: The HVAC system shall be observed in its shutdown condition. It shall be verified that power and main air are available at the HVAC system control panel.

b. Step 2 - Calibration Accuracy Check with HVAC System Shutdown: Readings shall be taken with a digital thermometer at each temperature-sensing element location. Each controller display shall be read, and the thermometer and controller-display readings logged. The calibration accuracy of the sensing element-to-controller readout for outside-air temperature and system-supply temperature shall be checked.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuator using the controller "MANUAL/AUTO" station in "MANUAL." The proper operation of the actuators and positioners for all valves shall be verified visually. The signal shall be varied from live zero of 4 ma to 20 ma, and it shall be verified that the actuators travel from zero stroke to full stroke within the signal range. It shall be verified that all sequenced actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other. Example: NC actuators are closed at 4 ma and are open at 20 ma. The signal levels that move the controlled device to its extreme positions shall be logged.

d. Step 4 - Control-System Commissioning:

(1) The outside-air temperature controller "MANUAL/AUTO" station shall be indexed to the "MANUAL" position and the two-point calibration sensing element-to-controller readout accuracy check for the outside-air temperature performed. The controller proportional band adjustment, the setpoint, the manual reset, and the maximum controller output shall be set to achieve the outside-air temperature schedule as shown.

(2) A signal shall be applied to simulate that the outside-air temperature is above the setpoint as shown. It shall be verified that pumps CP-1 and BP-1 and boiler B-1 stop. A signal shall be applied to simulate that the outside-air temperature is below the setpoint as shown. It shall be verified that pumps CP-1 and BP-1 start and boiler B-1 operates.

(3) The system's supply-temperature controller "MANUAL/AUTO" station shall be indexed to the "MANUAL" position, and the two-point calibration accuracy check of the sensing element-to-controller readout for the system-supply temperature performed. The controller shall be placed in the remote-setpoint mode. The remote setpoint for temperature schedule shall be set as shown. The controller "MANUAL/AUTO" station shall be indexed to the "AUTO" position, and the controller setup and tuning procedures performed. The controller shall be set at a system-supply temperature setpoint within the schedule as shown and the mode-constant setpoints logged. Signals of 8 ma and 16 ma shall be sent to the remote setpoint from the outside-air temperature controller, to verify that the controller setpoint changes to the appropriate values. The outside-air temperature controller's "MANUAL/AUTO" station shall be indexed to "AUTO."

3.4.9 NOT USED

3.4.10 NOT USED

3.4.11 NOT USED

3.4.12 NOT USED

3.4.13 Repair Bay Ventilation System (MAV, VEF's and EF)

Steps for installation are as follows:

a. Step 1 - System Inspection: The HVAC system shall be observed in its shutdown condition. Power and main air shall be available at the HVAC system control panel. The outside-air damper and relief-air damper shall be closed and the return-air damper shall be open.

b. Step 2 - Calibration Accuracy Check with HVAC System Shutdown: Readings shall be taken with a digital thermometer at each temperature-sensing element location. Each controller display shall be read, and the thermometer and controller-display readings logged. The calibration accuracy of the sensing element-to-controller readout for space temperature shall be checked.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuator, using the controller "MANUAL/AUTO" station in "MANUAL." The proper operation of the actuators and positioners for all dampers and valves shall be verified. The signal shall be varied from live zero of 4 ma to 20 ma, and it shall be verified that the actuators travel from zero stroke to full stroke within the signal range. It shall be verified that all sequenced and parallel-operated actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other.

d. Step 4 - Control-System Commissioning:

(1) With the fan ready to start, the ventilation-delay-mode signal shall be applied, and it shall be verified that the ventilation-delay-mode pilot light turns on. The occupied-mode signal shall be applied and it shall be verified that the occupied-mode pilot light turns on and that supply fan MAV-1 starts. It shall be verified that the outside-air and relief-air dampers are closed, the return-air damper is open, and the heating-coil valve is under control, by slightly changing the controller outputs. The ventilation-delay-mode signal shall be released, and it shall be verified that the ventilation-delay-mode pilot light turns off and that the outside-air, return-air, and relief-air dampers come under control by changing the controller output.

(2) The minimum-outside-air-mode signal shall be applied. It shall be verified that the outside-air damper opens to minimum position and the economizer pilot light is off.

(3) The space-temperature controller "MANUAL/AUTO" station shall be indexed to the "MANUAL" position, and the calibration accuracy check for sensing element-to-controller readout shall be performed. The controller shall be placed in the remote-setpoint mode. The setpoint low-end limit shall be set to 66 degrees F and the high-end limit shall be set to 72 degrees F. Proper operation of the temperature setpoint device at the space temperature sensing element and transmitter location shall be verified. The controller "MANUAL/AUTO" station shall be indexed to the "AUTO" position and the controller-tuning procedure shall be performed. The temperature setpoint device shall be set to the space temperature setpoint as shown.

(4) An unoccupied-mode signal shall be applied, and it shall be verified that the occupied-mode pilot light turns off, the HVAC system shuts down, and the control system assumes the specified shutdown conditions. The night-thermostat temperature setting shall be turned upward, and it shall be verified that the HVAC system starts; the setting shall be turned downward, and it shall be verified that the HVAC system stops. The night thermostat shall be set at the setpoint as shown.

(5) With the HVAC system running, a filter differential-pressure switch input signal shall be simulated, at the device. It shall be verified that the filter pilot light turns on, and that contact output at EMCS terminals is made. The differential-pressure switch shall be set at the setpoint as shown.

(6) With the HVAC system running, a freezestat trip input signal shall be simulated, at the device. HVAC system shutdown shall be observed. It shall be verified that the low-temperature pilot light turns on and that contact output at the EMCS terminals is made. The freezestat shall be set at the setpoint as shown. The HVAC shall be restarted by manual restart, and it shall be verified that the pilot light turns off.

(7) With the HVAC system running, a smoke-detector trip input signal shall be simulated at each detector, and verification of control-device actions and interlock functions as described in paragraph CONTROL SEQUENCES OF OPERATION shall be made. Simulation shall be performed without false-alarming any Life Safety systems. It shall be verified that the HVAC system shuts down and that the smoke-detector pilot light turns on, and contact output at EMCS terminals shall be verified. The detectors shall be reset. The HVAC system shall be restarted by manual reset, and it shall be verified that the pilot light turns off.

3.4.14 NOT USED

3.4.15 NOT USED

3.4.16 NOT USED

3.4.17 NOT USED

3.4.18 NOT USED

3.4.19 NOT USED

3.4.20 NOT USED

3.4.21 NOT USED

3.4.22 Single-Zone with Hydronic-Heating, Direct-Expansion Cooling With Return Fan

Steps for installation shall be as follows:

a. Step 1 - System Inspection: The HVAC system shall be verified in its shutdown condition. Power and main air shall be available at the HVAC system control panel. The outside-air and relief-air dampers shall be closed, the return-air damper shall be open, and all stages of cooling shall be off.

b. Step 2 - Calibration Accuracy Check with HVAC System Shutdown: Readings shall be taken with a digital thermometer at each temperature-sensing element location. Each controller display shall be read, and the thermometer and controller-display readings logged. The calibration accuracy of the sensing element-to-controller readout for outside-air, return-air, and space temperatures shall be checked.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuator, using the controller "MANUAL/AUTO" station in "MANUAL." The proper operation of the actuators and positioners for all dampers and valves shall be verified. The signal shall be varied from live zero of 4 ma to 20 ma, and it shall be verified that the actuators travel from zero stroke to full stroke within the signal range. It shall be verified that all sequenced and parallel-operated actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other. The signal levels that move the controlled device to its extreme positions shall be logged. The operating points of the sequence shall be set for each stage of cooling and the proper operation of each stage shall be verified.

d. Step 4 - Control-System Commissioning:

(1) With the fan ready to start, the ventilation-delay-mode signal shall be applied, and it shall be verified that the ventilation-delay-mode pilot light turns on. The occupied-mode signal shall be applied, and it shall be verified that the occupied-mode pilot light turns on and that supply fan AHV-1, Return Fan RF-1 and Exhaust Fans EF-2 and EF-3 starts. It shall be verified that the outside-air and relief-air dampers are closed, the return-air damper is open, and the heating-coil and stages of cooling are under control, by slightly changing the controller output. The ventilation-delay-mode signal shall be released, and it shall be verified that the ventilation-delay-mode pilot light turns off and that the outside-air, return-air, and relief-air dampers come under control by changing the controller output.

(2) The minimum-outside-air-mode signal shall be applied. It shall be verified that the outside-air damper opens to minimum position and the economizer pilot light is off.

(3) The space-temperature controller "MANUAL/AUTO" station shall be indexed to the "MANUAL" position, and the calibration accuracy check for sensing element-to-controller readout performed. The controller shall be placed in the remote-setpoint mode. The setpoint low-end limit shall be set to 66 degrees F and the high-end limit shall be set to 72 degrees F. Proper operation of the temperature setpoint device at the space-temperature sensing element and transmitter location shall be verified. The controller "MANUAL/AUTO" station shall be indexed to the "AUTO" position, and the controller-tuning procedure shall be performed. The temperature setpoint device shall be set to the space temperature setpoint as shown. A change in space temperature shall be simulated and it shall be verified that the heating-coil valve and the stages of D/X cooling operate in sequence as shown.

(4) An unoccupied-mode signal shall be applied, and it shall be verified that the occupied-mode pilot light turns off, the HVAC system shuts down, and the control system assumes the specified shutdown conditions. The night-thermostat temperature setting shall be turned upward, and it shall be verified that the HVAC system starts; the setting shall be turned downward, and it shall be verified that the HVAC system stops. The night thermostat shall be set at the setpoint as shown.

(5) With the HVAC system running, a filter differential-pressure switch input signal shall be simulated at the device. It shall be verified that the filter pilot light turns on, and that contact output at the EMCS terminals is made. The differential-pressure switch shall be set at the setpoint as shown.

(6) With the HVAC system running, a freezestat trip input signal shall be simulated at the device. HVAC system shutdown shall be verified; the low-temperature pilot light shall turn on, and contact output at the EMCS terminals shall be verified. The freezestat shall be set at the setpoint as shown. The HVAC system shall be restarted by manual restart, and it shall be verified that the pilot light turns off.

(7) With the HVAC system running, a smoke-detector trip input signal shall be simulated at each detector, and control-device actions and interlock functions as described in paragraph CONTROL SEQUENCES OF OPERATION shall be verified. Simulation shall be performed without false-alarming any Life Safety systems. It shall be verified that the HVAC system shuts down and that the smoke-detector pilot light turns on, and contact output at the EMCS terminals is made. The detectors shall be reset. The HVAC system shall be restarted by manual restart, and it shall be verified that the pilot light turns off.

3.5 BALANCING, COMMISSIONING, AND TESTING



#### 3.5.1 Coordination with HVAC System Balancing

Commissioning of the control system, except for tuning of controllers, shall be performed prior to or simultaneous with HVAC system balancing. The Contractor shall tune the HVAC control system after all air-system and hydronic-system balancing has been completed, minimum damper positions set and a report has been issued.

#### 3.5.2 Control System Calibration, Adjustments, and Commissioning

Control system commissioning shall be performed for each HVAC system, using test plans and procedures previously approved by the Government. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform commissioning and testing of the HVAC control system. All instrumentation and controls shall be calibrated and the specified accuracy shall be verified using test equipment with calibration traceable to NIST standards. Wiring shall be tested for continuity and for ground, open, and short circuits. Mechanical control devices shall be adjusted to operate as specified. HVAC control panels shall be pretested off-site as a functioning assembly ready for field connections, calibration, adjustment, and commissioning of the operational HVAC control system. Written notification of any planned commissioning or testing of the HVAC Control systems shall be given to the Government at least 14 calendar days in advance.

#### 3.5.3 Performance Verification Test

The Contractor shall demonstrate compliance of the HVAC control system with the contract documents. Using test plans and procedures previously approved by the Government, the Contractor shall demonstrate all physical and functional requirements of the project. The performance verification test shall show, step-by-step, the actions and results demonstrating that the control systems perform in accordance with the sequences of operation. The performance verification test shall not be started until after receipt by the Contractor of written permission by the Government, based on Government approval of the commissioning report and completion of balancing. The tests shall not be conducted during scheduled seasonal off-periods of base heating and cooling systems.

#### 3.5.4 Posted and Panel Instructions

Posted and panel instructions, showing the final installed conditions, shall be provided for each system. The posted instructions shall consist of half-size laminated drawings and shall include the control system schematic, equipment schedule, ladder diagram, sequence of operation, panel arrangement drawings, wiring diagram, and valve and damper schedules. The posted instructions shall be permanently affixed, by mechanical means, to a wall near the control panel. Panel instructions shall consist of laminated letter-size sheets and shall include a routine maintenance checklist and controller configuration check sheets with final configuration record for each controller. Panel instructions and one copy of the operation and maintenance manuals, previously described herein, shall be placed inside each control panel.

### 3.6 TRAINING

#### 3.6.1 Training-Course Requirements

A training course shall be conducted for operating staff members designated by the Contracting Officer. The training period, for a total of 32 hours of normal working time, shall be conducted within 30 days after successful completion of the performance verification test. The training course shall be conducted at the project site. Audiovisual equipment and sets of all other

training materials and supplies shall be provided. A training day is defined as 8 hours of classroom instruction, including two 15-minute breaks and excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility.

### 3.6.2 Training-Course Content

For guidance in planning the required instruction, the Contractor shall assume that attendees will have a high school education or equivalent, and are familiar with HVAC systems. The training course shall cover all of the material contained in the operating and maintenance instructions, the layout and location of each HVAC control panel, the layout of one of each type of unitary equipment and the locations of each, the location of each system-control device external to the panels, the location of the compressed-air station, preventive maintenance, troubleshooting, diagnostics, calibration, adjustment, commissioning, tuning, and repair procedures. Typical systems and similar systems may be treated as a group, with instruction on the physical layout of one such system. The results of the performance verification test and the calibration, adjustment and commissioning report shall be presented as benchmarks of HVAC control-system performance by which to measure operation and maintenance effectiveness.

--END OF SECTION--

## SECTION C-15990

### TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1 (1989) National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems

##### NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB-01 (1991) Procedural Standards for Testing Adjusting Balancing of Environmental Systems

##### 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having a "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

###### SD-01 Data

TAB Related HVAC Submittals; FIO.

A list of the TAB Related HVAC Submittals, no later than 7 days after the approval of the TAB Specialist.

###### SD-04 Drawings

TAB Schematic Drawings and Report Forms; GA.

Three copies of the TAB Schematic Drawings and Report Forms, no later than 21 days prior to the start of TAB field measurements.

###### SD-06 Instructions

TAB Procedures; GA.

Proposed procedures for TAB, submitted with the TAB Schematic Drawings and Report Forms.

###### SD-07 Schedules

Systems Readiness Check; FIO.

Proposed date and time to begin the Systems Readiness Check, no later than 7 days prior to the start of the Systems Readiness Check.

TAB Execution; GA.

Proposed date and time to begin field measurements, making adjustments, etc., for the TAB Report, submitted with the Systems Readiness Check Report.

TAB Verification; GA.

Proposed date and time to begin the TAB Verification, submitted with the TAB Report.

#### SD-08 Statements

TAB Firm; GA.

Certification of the proposed TAB Firm's qualifications by either AABC or NEBB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Firm or disciplinary action taken by AABC or NEBB against the proposed TAB Firm shall be described in detail.

TAB Specialist; GA.

Certification of the proposed TAB Specialist's qualifications by either AABC or NEBB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Specialist or disciplinary action taken by AABC or NEBB against the proposed TAB Specialist shall be described in detail.

Instrument Calibration; FIO.

List of each instrument to be used during TAB, stating calibration requirements required or recommended by both the TAB Standard and the instrument manufacturer and the actual calibration history of the instrument, submitted with the TAB Procedures. The calibration history shall include dates calibrated, the qualifications of the calibration laboratory, and the calibration procedures used.

#### SD-09 Reports

Design Review Report; GA.

A copy of the Design Review Report, no later than 14 days after approval of the TAB Firm and the TAB Specialist.

Systems Readiness Check Report; GA.

A copy of completed checklists for each system, each signed by the TAB Specialist, at least 7 days prior to the start of TAB Execution. All items in the Systems Readiness Check Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

TAB Report; GA.

Three copies of the completed TAB Reports, no later than 7 days after the execution of TAB. All items in the TAB Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

TAB Verification Report; GA.

Three copies of the completed TAB Verification Report, no later than 7 days after the execution of TAB Verification. All items in the TAB Verification Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

#### SD-13 Certificates

Ductwork Leak Testing; FIO.

A written statement signed by the TAB Specialist certifying that the TAB Specialist witnessed the Ductwork Leak Testing, it was successfully completed, and that there are no known deficiencies related to the ductwork installation that will prevent TAB from producing satisfactory results.

### 1.3 SIMILAR TERMS

In some instances, terminology differs between the Contract and the TAB Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results. The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC or NEBB requirements where differences exist.

#### SIMILAR TERMS

Contract Term	AABC Term	NEBB Term
TAB Standard	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems	Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
TAB Specialist	TAB Engineer	TAB Supervisor
Systems Readiness Check	Construction Phase Inspection	Field Readiness Check & Preliminary Field Procedures.

### 1.4 TAB STANDARD

TAB shall be performed in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1 or NEBB-01, unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard shall be considered mandatory. The provisions of the TAB Standard, including checklists, report forms, etc., shall, as nearly as practical, be used to satisfy the Contract requirements. The TAB Standard shall be used for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, the manufacturer's recommendations shall be adhered to. All quality assurance provisions of the TAB Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures shall be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC or NEBB), the requirements and recommendations contained in these procedures and requirements shall be considered mandatory.

### 1.5 QUALIFICATIONS

#### 1.5.1 TAB Firm

The TAB Firm shall be either a member of AABC or certified by the NEBB and certified in all categories and functions where measurements or performance are specified on the plans and specifications, including TAB of environmental systems building systems commissioning and the measuring of sound and vibration in environmental systems. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Firm for approval. Any firm that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Firm shall be considered invalid if the TAB Firm loses its certification prior to Contract completion and must be performed by an approved successor.

#### 1.5.2 TAB Specialist

The TAB Specialist shall be either a member of AABC or an experienced technician of the Firm certified by the NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

#### 1.6 TAB SPECIALIST RESPONSIBILITIES

All TAB work specified herein and in related sections shall be performed under the direct guidance of the TAB Specialist.

#### PART 2 PRODUCTS (Not Applicable)

#### PART 3 EXECUTION

##### 3.1 DESIGN REVIEW

The TAB Specialist shall review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the HVAC systems from effectively operating in accordance with the sequence of operation specified or prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

##### 3.2 TAB RELATED HVAC SUBMITTALS

The TAB Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful accomplishment of all HVAC TAB. The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the TAB Specialist when submitted to the Government. The TAB Specialist shall also ensure that the location and details of ports, terminals, connections, etc., necessary to perform TAB are identified on the submittals.

### 3.3 TAB SCHEMATIC DRAWINGS AND REPORT FORMS

A schematic drawing showing each system component, including balancing devices, shall be provided for each system. Each drawing shall be accompanied by a copy of all report forms required by the TAB Standard used for that system. Where applicable, the acceptable range of operation or appropriate setting for each component shall be included on the forms or as an attachment to the forms. The schematic drawings shall identify all testing points and cross reference these points to the report forms and procedures.

### 3.4 DUCTWORK LEAK TESTING

The TAB Specialist shall witness the Ductwork Leak Testing specified in Section C-15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM and approve the results as specified in Paragraph TAB RELATED HVAC SUBMITTALS.

### 3.5 TESTING, ADJUSTING, AND BALANCING

#### 3.5.1 General

Doors and windows surrounding each area to be balanced shall be closed during testing and balancing operations. Air systems shall be complete and operable with balancing dampers, ducting, diffusers, returns, flow control boxes and control components in place. Exhaust fans and fume hoods shall be operational. Hydronic systems shall be complete and operable with balancing valves, flow meters, coils, pumps, piping and control components in place. Air motion and distribution from air terminals shall be as shown. Smoke tests may be used to demonstrate proper air distribution from air terminals. All data including deficiencies encountered and corrective action taken shall be recorded. If a system cannot be adjusted to meet the design requirements, the Contractor shall promptly notify the Contracting Officer in writing.

#### 3.5.2 Air Systems

Clean filters shall be installed at the beginning of the testing, adjusting, and balancing effort. Each system shall be adjusted until all flow quantities are within plus ten percent and minus zero percent. Dampers shall be checked for tight shutoff. Air leakage around dampers shall be verified. Fire dampers shall be open. Fans shall be checked for correct direction of rotation and proper speed shall be verified. Fire dampers shall be tested at system design air flow to ensure proper closure in accordance with NFPA 90A and manufacturer's instructions prior to building occupancy.

##### 3.5.2.1 General Balancing Methods

In addition to the requirements for specific systems, flows in supply, exhaust and return air systems shall be balanced using the methods in standard selected in TAB STANDARDS. Throttling losses shall be limited. Air flow adjustments shall be made by first adjusting the fan speed to meet the design flow conditions. Fan speed adjustment may not be required for fan motors which are less than one horsepower, or if throttling results in no greater than an additional 1/3 horsepower draw above that required if the fan speed were adjusted. Flows and pressures shall be checked in all main risers and supply ducts at all supply, exhaust and return fan discharges. All flows shall be recorded before and after each adjustment.

##### 3.5.2.2 Specific Systems

All special or additional procedures for testing and balancing shall be in accordance with the applicable requirements of the standard selected in TAB STANDARDS. If a system has diversity, only the required quantity of wide open terminals shall be used to meet the design air flow.

### 3.5.3 Hydronic Systems

All valves and control components shall be open or set as required for maximum system flow. Each system shall be adjusted until all flow quantities are within the tolerances of the standard selected in paragraph GENERAL REQUIREMENTS. Pumps shall be checked for proper speed. Pump activation signal and deactivation signal valves shall be verified. Pump motor current shall be checked at maximum design flow.

#### 3.5.3.1 General Balancing Methods

In addition to the requirements for specific systems, flows in piping, coils and other hydronic system components shall be balanced using the flow meter, equipment pressure drop or pump curve methods in accordance with the applicable provisions of the standard selected in TAB STANDARDS. Flows shall be checked in all main risers and branches and at all heating coils, heat exchangers, boilers, and pump discharges. Pressure taps on all pumps shall be made at factory suction and discharge tappings where available. All flows shall be recorded before and after each adjustment.

#### 3.5.3.2 Specific Systems

Where specific systems require special or additional procedures for testing and balancing, such procedures shall be in accordance with the standard selected in TAB STANDARDS. If a system has diversity, only the required quantity of wide-open terminals shall be used to meet the design water flow.

a. Primary-Secondary: Primary-secondary systems shall be treated as separate systems. Primary systems shall be balanced first with the secondary systems running. Secondary systems shall then be balanced.

b. Summer-Winter: Summer-winter systems shall be balanced in the summer mode of operation. Following completion of the summer-mode balancing, equipment used for winter operation shall be balanced.

### 3.5.4 Vehicle Exhaust Systems

All tests and measurements shall be performed in accordance with TAB STANDARDS for similar exhaust system components. Air flow rates at each exhaust outlet shall be equal quantities, unless otherwise shown, with the system exhaust fan providing the total air flow rate shown.

### 3.5.5 Control Systems

Testing, adjusting, and balancing of the systems shall be coordinated with the control system installation. All control components shall be verified to be properly installed and operating as specified before proceeding with testing, adjusting, and balancing. Verification shall be in accordance with TAB STANDARDS.

### 3.5.6 TAB Procedures

Step by step procedures for each measurement required during TAB Execution shall be provided. The procedures shall be oriented such that there is a separate



section for each system. The procedures shall include measures to ensure that each system performs as specified in all operating modes, interactions with other components (such as exhaust fans, fume hoods, relief vents, etc.) and systems, and with all seasonal operating differences, diversity, simulated loads, and pressure relationships required.

#### 3.5.7 Systems Readiness Check

The TAB Specialist shall inspect each system to ensure that it is complete, including installation and operation of controls, and that all aspects of the facility that have any bearing on the HVAC systems, including installation of ceilings, walls, windows, doors, and partitions, are complete to the extent that TAB results will not be affected by any detail or touch-up work remaining. The TAB Specialist shall also verify that all items such as ductwork and piping ports, terminals, connections, etc., necessary to perform TAB shall be complete during the Systems Readiness Check.

#### 3.5.8 Preparation of TAB Report

Preparation of the TAB Report shall begin only when the Systems Readiness Report has been approved. The Report shall be oriented so that there is a separate section for each system. The Report shall include a copy of the appropriate approved Schematic Drawings and TAB Related Submittals, such as pump curves, fan curves, etc., along with the completed report forms for each system. The operating points measured during successful TAB Execution and the theoretical operating points listed in the approved submittals shall be marked on the performance curves and tables. Where possible, adjustments shall be made using an "industry standard" technique which would result in the greatest energy savings, such as adjusting the speed of a fan instead of throttling the flow. Any deficiencies outside of the realm of normal adjustments and balancing during TAB Execution shall be noted along with a description of corrective action performed to bring the measurement into the specified range. If, for any reason, the TAB Specialist determines during TAB Execution that any Contract requirement cannot be met, the TAB Specialist shall immediately provide a written description of the deficiency and the corresponding proposed corrective action necessary for proper system operation to the Contracting Officer.

#### 3.5.9 TAB Verification

The TAB Specialist shall recheck ten percent of the measurements listed in the Tab Report and prepare a TAB Verification Report. The measurements selected for verification and the individuals that witness the verification will be selected by the Contracting Officer's Representative (COR). The measurements will be recorded in the same manner as required for the TAB Report. All measurements that fall outside the acceptable operating range specified shall be accompanied by an explanation as to why the measurement does not correlate with that listed in the TAB Report and a description of corrective action performed to bring the measurement into the specified range. If over 20 percent of the measurements selected by the COR for verification fall outside of the acceptable operating range specified, the COR will select an additional ten percent for verification. If over 20 percent of the total tested (including both test groups) fall outside of the acceptable range, the TAB Report shall be considered invalid and all contract TAB work shall be repeated beginning with the Systems Readiness Check.

#### 3.5.10 Marking of Setting

Following approval of TAB Verification Report, the setting of all HVAC adjustment devices including valves, splitters, and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time.

#### 3.5.11 Identification of Test Ports

The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leakage or to maintain integrity of vapor barrier.

--END OF SECTION--

SECTION C-16375

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

FEDERAL SPECIFICATIONS (FS)

FS RR-F-621 (Rev E) Frames, Covers, Gratings,  
Steps, Sump and Catch Basin, Manhole

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO LTS-2 (1985; Rev 1986, 1987, 1988) Standard  
Specifications for Structural Supports for  
Highway Signs, Luminaires and Traffic Signals

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C29.1 (1988) Electrical Power Insulators - Test  
Methods

ANSI C37.50 (1989) Low-Voltage AC Power Circuit  
Breakers Used in Enclosures - Test Procedures

ANSI C57.12.13 (1982) Conformance Requirements for  
Liquid-Filled Transformers Used in Unit  
Installations, Including Unit Substations

ANSI C57.12.21 (1980) Requirements for Pad-Mounted  
Compartmental-Type, Self-Cooled, Single-Phase  
Distribution Transformers with High-Voltage  
Bushings; High-Voltage, 34 500 GrdY/19 920  
Volts and Below; Low-Voltage, 240/120 Volts;  
167 kVA and Smaller

ANSI C57.12.27 (1982) Liquid-Filled Distribution  
Transformers Used in Pad-Mounted  
Installations, Including Unit Substations

ANSI C78.1350 (1990) 400-Watt, 100-volt, S51 Single-Ended  
High-Pressure Sodium Lamps

ANSI C80.1 (1990) Rigid Steel Conduit - Zinc Coated

ANSI C82.4 (1985; C82.4a) Ballasts for High-  
Intensity-Discharge and Low-Pressure  
Sodium Lamps (Multiple-Supply Type)

ANSI C119.1 (1986) Sealed Insulated Underground  
Connector Systems Rated 600 Volts

ANSI C135.1 (1979) Galvanized Steel Bolts and Nuts for

Overhead Line Construction

ANSI C136.2	(1985) Luminaries Voltage Classifications
ANSI C136.3	(1989) Luminarie Attachments - for Roadway Lighting Equipment
ANSI C136.6	(1990) Roadway Lighting Equipment - Metal Heads and Reflector Assemblies Mechanical & Optical Interchangeability
ANSI C136.9	(1990) Roadway Lighting Equipment - Socket Support Assemblies Metal Heads - Mechanical Interchangeability
ANSI C136.10	(1988) Locking-type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing for Roadway Lighting Equipment
ANSI C136.11	(1988) Multiple Sockets for Roadway Lighting Equipment
ANSI C136.15	(1986) High-Intensity-Discharge and Low-Pressure Sodium Lamps in Liminaires - Field Identification
ANSI O5.1	(1992) Specifications and Dimensions for Wood Poles

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48	(1983; R 1990) Gray Iron Castings
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	(1982; R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B 8	(1990) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 117	(1990) Salt Spray (Fog) Testing
ASTM C 478	(1990b) Precast Reinforced Concrete Manhole Sections
ASTM D 923	(1991) Sampling Electrical Insulating Liquids
ASTM D 1654	(1979a; R 1984) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 4059	(1991) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography
ASTM F 883	(1990) Padlocks

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS5 (1987) Thermoplastic and Cross-linked  
Polyethylene Insulated Shielded Power Cables  
Rated 5 Through 35 kV

AEIC CS6 (1987; Rev Mar 1989) Ethylene  
Propylene Rubber Insulated Shielded Power  
Cables Rated 5 Through 69 kV

FACTORY MUTUAL ENGINEERING AND RESEARCH CORPORATION (FM)

FM P7825 (1992; Supple I, II, and III)  
Approval Guide

FEDERAL SPECIFICATIONS (FS)

FS HH-I-595 (Rev C) Insulation Tape, Electrical,  
Pressure-Sensitive Adhesive, Plastic

FS W-F-1814/GEN (Rev A; Supple 1, Notice 1) Fuses,  
Cartridge, High-Interrupting Capacity

FS W-S-610 (Rev E) Splice Connectors

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

IEEE C2 (1997) National Electrical Safety Code

IEEE C37.23 (1987; R 1991) Guide for Metal-Enclosed  
Bus and Calculating Losses in Isolated -  
Phase Bus

IEEE C37.30 (1971; C37.30c; C37.30e; C37.30g;  
C37.30h; R 1987) Definitions and Requirements  
for High-Voltage Air Switches, Insulators,  
and Bus Supports

IEEE C37.34 (1971; R 1987; C37.34a; C37.34b;  
C37.34d; C37.34e) Test Code for  
High-Voltage Air Switches

IEEE C37.41 (1988; 37.41c) Design Tests for  
High-Voltage Fuses, Distribution Enclosed  
Single-Pole Air Switches, Fuse Disconnecting  
Switches, and Accessories

IEEE C57.12.00 (1987) Liquid-Immersed Distribution,  
Power, and Regulating Transformers

IEEE C57.13 (1978; R 1986) Instrument Transformers

IEEE C57.98 (1986) Guide for Transformer Impulse  
Tests - Appendix to C57.12.90

IEEE C62.1 (1989) Standard for Gapped  
Silicon-Carbide Surge Arresters for AC Power  
Circuits

IEEE C62.2 (1987) Guide for the Application of

Gapped Silicon-Carbide Surge Arresters for  
Alternating Current Systems

IEEE C62.11	(1987) Metal-Oxide Surge Arresters for AC Power Circuits
IEEE Std 48	(1990) Standard Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminations
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE Std 100	(1988) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 386	(1985; R 1991) Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE Std 404	(1986) Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V through 46 000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V Through 500 000 V
IEEE Std 590	(1977; R 1991) Cable Plowing Guide
IEEE Std 592	(1990) Exposed Semiconducting Shields on High Voltage Joints and Separable Insulated Connectors

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IES)

IES RP-8	(1983) Roadway Lighting
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA FB 1	(1988) Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
NEMA LA 1	(1986) Surge Arresters
NEMA SG 2	(1986) High-Voltage Fuses
NEMA TC 6	(1990) PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA WC 7	(1988) Cross-Linked-Thermosetting - Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	(1988) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 6 (1981; Rev thru Dec 1992) Rigid Metal Conduit

UL 198E (1988; Rev Jul 1988) Class R Fuses

UL 467 (1984; Rev thru Nov 1986) Grounding and Bonding Equipment

UL 486A (1991; Rev Oct 1991) Wire Connectors and Soldering Lugs for Use with Copper Conductors

UL 486B (1991; Rev thru Apr 1992) Wire Connectors for Use with Aluminum Conductors

UL 510 (1994) Insulating Tape

UL 514A (1991) Metallic Outlet Boxes

UL 651 (1989; Rev thru Dec 1989) Schedule 40 and 80 Rigid PVC Conduit

UL 854 (1991; Rev Dec 1992) Service-Entrance Cables

UL 1029 (1986; Rev thru Nov 1991) High-Intensity-Discharge Lamp Ballasts

UL 1242 (1983; Rev thru Jan 1993) Intermediate Metal Conduit

UL 1572 (1991; Rev thru Jun 1992) High Intensity Discharge Lighting Fixtures

1.2 GENERAL REQUIREMENTS

1.2.1 Terminology

Terminology used in this specification is as defined in IEEE Std 100.

1.2.2 NOT USED

1.3 SUBMITTALS

Governmental approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-01 Data

Short-Circuit and Protective Devices Coordination Studies; FIO.

Studies which demonstrate that the equipment selected and system constructed meet the contract requirements for equipment ratings, coordination, and protection. The studies shall include a complete single-line diagram of the power system

covered by this specification; a short circuit study including the maximum and minimum values of short circuit currents at major buses extended down to system buses where currents are equal to 10,000 amperes symmetrical; utility company data including system voltages, fault MVA, system X/R ratio, time-current characteristic curves, current transformer ratios, and relay device numbers and settings; and existing power system data including time-current characteristic curves and protective device ratings and settings; fully coordinated composite time-current characteristic curves including recommended ratings and settings of all protective devices in tabulated form; and associated calculations to demonstrate that the power system protection will be selectively coordinated by the use of devices or equipment submitted. Situations where system coordination is not achievable due to device limitations shall be noted. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last three years. The Contractor shall provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

Manufacturer's Catalog Data; GA.

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists; FIO.

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

Installation Procedures; FIO.

As a minimum, installation procedures for transformers, substations, switchgear, and medium-voltage cable terminations and splices.

Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

#### SD-04 Drawings

Electrical Distribution System; FIO.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:



a. Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.

b. Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

Detail drawings shall as a minimum depict the installation of the following items:

a. Transformers.

b. Transclosure.

c. Fixtures.

As-Built Drawings; FIO.

The as-built drawings shall be a record of the construction as installed. The drawings shall include all the information shown on the contract drawings as well as all deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect all deviations, modifications, and changes. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall submit three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within ten calendar days from the time the drawings are returned to the Contractor.

SD-09 Reports

Factory Test; FIO.

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests specified in applicable publications or in these specifications. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included.

Field Testing; GA.

A proposed field test plan, 20 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Test Reports; GA.

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of 5 rings from which material may readily be moved and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

- a. A list of all equipment used, with calibration certifications.
- b. A copy of all measurements taken.
- c. The dates of testing.
- d. The equipment and values to be verified.
- e. The condition specified for the test.
- f. The test results, signed and dated.
- g. A description of all adjustments made.

#### SD-13 Certificates

Materials and Equipment; FIO.

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), the Contractor shall submit proof that the items provided under this section of the specifications conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

#### SD-19 Operation and Maintenance Manuals

Electrical Distribution System; GA.

Six copies of Operation and Maintenance manuals, within 7 calendar days following the completion of tests and including assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked. Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering

information, drawings, instructions, and spare parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers.

Three additional copies of the instructions manual, within 30 calendar days following the approval of the manuals.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ANSI O5.1. Handling of wood poles shall be in accordance with ANSI O5.1, except that pointed tools capable of producing indentations more than 1 inch in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

#### 1.5 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the contracting officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

### PART 2 PRODUCTS

#### 2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

#### 2.2 NAMEPLATES

##### 2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal. Equipment containing liquid dielectrics shall have the type of dielectric on the nameplate. Sectionalizer switch nameplates shall have a schematic with all switch positions shown and labeled. As a minimum, nameplates shall be provided for transformers, circuit breakers, meters, switches, and switchgear.

##### 2.2.2 Liquid-Filled Transformer Nameplates

Nameplates shall indicate percent impedance, voltage, kVA, frequency, number of phases, cooling class, insulation class, temperature rise, the number of gallons and composition of liquid-dielectric, and shall be permanently marked with a statement that the dielectric supplied is non-polychlorinated biphenyl. If transformer nameplate is not so marked, the Contractor shall furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified, with less than 1 ppm PCB content in accordance with paragraph LIQUID

DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 1 ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

Rebuilt or reconditioned transformers will not be installed.

A nameplate will be provided on all transformers that says "NON-PCB" or "LESS THAN 1 PPM PCB". In addition to the nameplate PCB-free designation, all transformers will have a "No PCB's" per EPA regulations. Stickers shall be visible from the ground. The sticker shall be 2" wide by 1" high, UV fade resistant, pressure sensitive adhesive backing, blue background with white letters, suitable for all weather conditions. Source of supply is Style PCNL as manufactured by Labelmaster Hazardous Materials Safety Products, 1996 General Catalog G-110.

The following information will be forwarded to the Environmental Division for updating of the Fort Campbell database:

- Manufacturer
- Model Number
- Serial Number
- Manufacture Date
- KVA
- Primary Voltage
- Secondary Voltage
- Installation Date
- State Installed
- Location Installed.

Any oil equipment used shall be non-PCB.

## 2.3 CORROSION PROTECTION

### 2.3.1 Aluminum Materials

Aluminum shall not be used.

### 2.3.2 Ferrous Metal Materials

#### 2.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153 and ASTM A 123.

#### 2.3.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaires not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 120 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

### 2.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified in Section 09900 PAINTING, GENERAL.

## 2.4 CABLES

Cables shall be single conductor type unless otherwise indicated.

### 2.4.1 Conductor Material

Underground cables shall be of soft drawn copper conductor material.

### 2.4.2 Medium-Voltage Cables

#### 2.4.2.1 General

Medium voltage cables shall conform to the requirements of NEMA WC 7 for cables utilizing cross-linked thermosetting polyethylene ((XLP) insulation and NEMA WC 8 for cables utilizing ethylene-propylene-rubber (EPR) insulation. Cables shall be in accordance with the requirements of NFPA 70. Single conductor cables shall be provided except as otherwise indicated.

#### 2.4.2.2 Insulation

Cables shall utilize cross-linked thermosetting polyethylene (XLP) or insulation ethylene-propylene-rubber (EPR) insulation. Cables shall be provided with 133 percent insulation level.

#### 2.4.2.3 Jackets

Cables shall be provided with a nonmetallic jacket. Concentric neutral cables for direct buried applications shall have a moisture-resistant, nonmetallic jacket rated for direct burial.

#### 2.4.2.4 Neutrals

Neutral conductors of grounded neutral systems except for concentric neutral cables shall be of the same insulation material as phase conductors, except that a 600-volt insulation rating is acceptable. Cables employing concentric neutral shall have full concentric neutral with an insulating jacket over the concentric neutral.

#### 2.4.2.5 Shielding

Cables rated for above 2 kV shall have both conductor and insulation shielding for each phase.

#### 2.4.2.6 Ratings

Medium-voltage cables shall be rated for a circuit voltage of 15 kV.

### 2.4.3 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70. Cables shall utilize cross-linked thermosetting polyethylene (XLP) insulation and shall conform to the requirements of NEMA WC 7 or ethylene-propylene-rubber (EPR) insulation and shall conform to the requirements of NEMA WC 8.

#### 2.4.3.1 Direct Buried

Direct buried cable applications shall be single conductor cable identified for such use and conforming to NEMA WC7 or NEMA WC8.

#### 2.4.3.2 In Duct

Cables shall be single-conductor cable, Type THWN, or XHHW in accordance with NFPA 70.

### 2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

#### 2.5.1 Medium-Voltage Cable Joints

Medium-voltage cable joints shall comply with IEEE Std 404 and IEEE Std 592. Medium-voltage cable terminations shall comply with IEEE Std 48. Joints shall be the standard products of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Joints shall have ratings not less than the ratings of the cables on which they are installed. All joints used in manholes, handholes, vaults and pull boxes shall be certified by the manufacturer for waterproof, submersible applications.

#### 2.5.2 Medium-Voltage Separable Insulated Connectors

Separable insulated connectors shall comply with IEEE Std 386 and IEEE Std 592 and shall be of suitable construction or standard splice kits shall be used. Splice kits may be of the heat-shrinkable type for voltages up to 15 kV, of the premolded splice and connector type, the conventional taped type, or the resin pressure-filled overcast taped type for voltages up to 35 kV; except that for voltages of 7.5 kV or less a resin pressure-filled type utilizing a plastic-tape mold is acceptable. Separable insulated connectors are acceptable for voltages up to 35 kV. Connectors shall be of the loadbreak type as indicated, of suitable construction for the application and the type of cable connected, and include cable shield adaptors. Separable insulated connectors shall not be used as substitutes for conventional permanent splices. External clamping points shall be provided.

#### 2.5.3 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A. Splices in conductors No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A and UL 486B. Splices shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

#### 2.5.4 Terminations

Terminations shall be in accordance with IEEE Std 48, Class 1 or Class 2; of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2

terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, and armor.

#### 2.5.4.1 Factory Preformed Type

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level.

#### 2.5.4.2 Taped Terminations

Taped terminations shall use standard termination kits providing terminal connectors, field-fabricated stress cones, and rain hoods. Terminations shall be at least 12-1/2 inches long from the end of the tapered cable jacket to the start of the terminal connector, or not less than the kit manufacturer's recommendations, whichever is greater.

### 2.6 CONDUIT AND DUCTS

Duct lines shall be concrete-encased, thin-wall type.

#### 2.6.1 Metallic Conduit

Intermediate metal conduit shall comply with UL 1242. Rigid galvanized steel conduit shall comply with UL 6 and ANSI C80.1. Metallic conduit fittings and outlets shall comply with UL 514A and NEMA FB 1.

#### 2.6.2 Nonmetallic Ducts

##### 2.6.2.1 NOT USED

##### 2.6.2.2 Concrete Encased Ducts

UL 651 Schedule 40 or NEMA TC 6 Type EB.

##### 2.6.2.3 NOT USED

#### 2.6.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall neither slump at a temperature of 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

### 2.7 MANHOLES, HANDHOLES, AND PULLBOXES

Manholes, handholes, and pullboxes shall be as indicated. Precast-concrete manholes shall have the required strength established by ASTM C 478. Frames and covers shall be made of gray cast iron and a machine-finished seat shall be provided to ensure a matching joint between frame and cover. In paved or gravel parking areas, frames and covers in vehicular traffic areas shall be rated for wheel loads in accordance with FS RR-F-621. Cast iron shall comply with ASTM A

48, Class 30B, minimum. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least 10,000 psi and a flexural strength of at least 5,000 psi. Pullbox and handhole covers in, sidewalks, and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

#### 2.7.1 Manhole Steps

Steps shall be provided in all manholes. Steps for manholes shall be spaced 12 inches apart and shall consist of No. 4 Grade 60 steel reinforcement encased in molded copolymer polypropylene plastic, PS1-PF, as manufactured by M.A. Industries, Inc.; Kelly & Dividend Drive, Peachtree City, Georgia, 30269; or approved equal.

#### 2.8 NOT USED

#### 2.9 ENCLOSED TRANSFORMER STATIONS

2.9.1 Transformer stations shall be of ratings and arrangements as indicated and shall be the outdoor type. The voltage rating of potheads, wiring, insulators, and cables for use on primary systems operating at 7,300 to 14,000 volts between phases shall be not less than 15,000 volts. Voltage ratings may be for grounded-neutral service when used on grounded-neutral systems.

2.9.1.1 Outdoor Stations: Transformers shall be mounted in a modular steel transclosure mounted on a concrete pad. Unless otherwise indicated the concrete pad shall be at least 8 inches thick, reinforced with a 6- by 6-inch No. 6 mesh and with a 6-inch well compacted gravel subbase. The top of the concrete pad shall be approximately 4 inches above the finished grade. The pad shall be of adequate size to project at least 8 inches beyond the equipment, with a 1-foot-minimum clear space between transformers. Concrete pad shall be Class B or 2,500 psi at 28 days and shall conform to SECTION: CONCRETE FOR BUILDING CONSTRUCTION. The transclosure shall be adequately grounded and connected to the transformer-station ground system as shown on the drawings.

2.9.2 Primary connections shall be of the type and capacity indicated. The ends of conduits within the station shall be equipped with suitable termination. Spare conduits shall be capped. High-voltage insulators of applicable type and method of mounting or heavy-duty secondary racks shall be installed as required to properly support open wiring. Unless otherwise indicated, the distance between supports shall not exceed 4 feet. Insulator fittings for insulated wire or cable shall be designed to fit tightly over the insulation and covering, and no part of the insulation or braid shall be removed at these points.

2.9.3 Transformers shall conform to NEMA Standard TR 1 except as modified by Fed. Spec. W-T-631 and as modified herein. Transformers shall be Type I, mineral-oil-insulated two-winding type, and in accordance with the requirements hereinafter stated. Transformer shall have copper windings, not aluminum. Transformers shall be suitable in every respect for outdoor installation and rated as indicated. Transformers shall be the product of a manufacturer who has produced units of the same type, rating, and voltage, and as required for this project, within the 3-year period preceding the date of the invitation for bids and shall be transformers that have operated satisfactorily for at least 1 year prior to date of the invitation for bids. Evidence showing such production and satisfactory performance and proved reliability of the product shall be promptly submitted to the Contracting Officer upon requires therefor. All transformers shall be provided with rated V NEMA standard adjustable taps. High-voltage



bushings shall be of the cover type. Low-voltage bushing shall be of the tank-wall type and mounted singly.

2.9.4 Standard Impulse-Test Procedure: The high-voltage winding of each transformer rated above 167 KVA shall be impulse-rated in conformance with NEMA Standard TR 1. Prior to final acceptance of the transformer by the Contracting Officer, the Contractor shall submit for approval the manufacturer's or a recognized independent testing laboratory's test reports in duplicate, similar to those covered in NEMA Standard TR 1, and as required above. Transformer tank shall have a standard gray finish. Transformers shall be completed with all accessory equipment in accordance with the NEMA Standard. Each transformer shall have its KVA rating conspicuously displayed on its tank.

2.9.5 Transformer enclosure shall be of modular construction. Doors shall be hinged inside and shall have 3 point latching. Screened ventilating openings shall be provided. Enclosure shall be constructed of 12 gauge carbon steel. Enclosure shall have dark green baked enamel finish. Enclosure shall have lexan shatterproof glass window to allow observance of the primary switch assembly. Enclosure shall be assembled and securely anchored to pad. Equipment rails, clips, and accessories shall be provided within enclosure to mount and support equipment as indicated. The enclosure shall include certain signs on the exterior which read "DANGER - HIGH VOLTAGE".

2.9.6 Wiring: The enclosure shall be wired with all the apparatus shown on the drawings and in the manner shown. The Contractor shall take care to insure that all the necessary clearances as required by the National Electrical Safety Code are maintained. The cable shall be trained and supported in a neat manner.

2.9.7 Grounding: Grounding shall be in accordance with paragraph 3.10 entitled "Grounding".

#### 2.9.8 Primary Switching Equipment

2.9.8.1 The primary switching equipment shall consist of an assembly of a three-pole, externally group-operated load-break air switches and one power fuse compartment within a free-standing weather-proof enclosure, suitable for pad mounting, with cable entry and exit through the bottom. The assembly shall be rated 14.4 kV, 95 kV BIL minimum. The assembly shall be arranged as described on the drawings. Submit shop drawings of the primary switching equipment to the Contracting Officer for approval.

2.9.8.2 Grounding studs shall be provided at all fuse terminals and cable terminating compartment terminals, plus a stud on grounding pad in each fuse terminal and cable terminating compartment.

2.9.8.3 The primary switches shall be group operated air break design, with quick make, quick break mechanism to control the switching blade speed independently of operator handle speed, and utilizing arc compressors or chutes to control circuit interruption without external arc or flame. Switches shall be 600 amp continuous and interrupting with three phase fault closing ratings of 12,500 amps RMS symmetrical for one time duty cycle. One time duty cycle fault closing rating is the fault current into which the switch can be closed on time and then remain operable with the capability of carrying and interrupting rated continuous current.

2.9.8.4 The fuse compartment shall be equipped with three power fuses and the necessary buswork, mounting hardware, terminal pads and cable termination space, each phase separated by insulating barriers, and including removable front barriers to prevent accidental contact with line parts. The power fuses shall use a solid material arc extinguishing medium for low energy release and low gas

generation during circuit interruption. The switch compartment shall be equipped with a storage rack and one set of spare fuse refill units, as well as a fuse handling tool.

2.9.8.5 Surge arresters shall be provided as indicated. Selection of arrester ratings and classification according to use shall be as described by NEMA Standard LA1. Arresters shall be equipped with suitable mounting brackets for the applicable method of mounting. They shall be grounded in accordance with paragraph 3.10.4 entitled "Surge-Arrester Grounding".

#### 2.9.9 Busways

Busways shall comply with NEMA BU 1 and UL 857 and shall be of the voltage, phase, and continuous current ratings indicated. Neutrals shall be full size. Busways shall have short-circuit ratings not less than the maximum short-circuit currents of associated transformers, assuming primary sources of infinite capacity. Busways shall be feeder-low-impedance type and of outdoor or indoor service construction as suitable to the location. Busways shall be complete with elbows, fittings, flanges, end-closures, tees, crosses, cable-tap boxes, accessories, and other devices required for the indicated installation, and shall be coordinated for connection to the indicated equipment. For wet/damp locations, bus duct shall be heated, nonventilated enclosure, nonsegregated phase type in accordance with IEEE C37.23. Detail drawings for busway supports and bracing shall be submitted in accordance with the detail drawings portion of paragraph SUBMITTALS and shall indicate that busways are adequately supported for seismic zone 2A.

#### 2.10 METERING AND PROTECTIVE DEVICES

##### 2.10.1 NOT USED

##### 2.10.2 Fuses, Medium-Voltage, Including Current-Limiting

Medium-voltage fuses, including current-limiting, shall comply with NEMA SG 2.

##### 2.10.3 NOT USED

##### 2.10.4 NOT USED

##### 2.10.5 NOT USED

#### 2.11 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1, IEEE C62.1, IEEE C62.2, and IEEE C62.11 and shall be provided where indicated. Arresters shall be distribution class, rated as shown. Arresters shall be equipped with mounting brackets suitable for the indicated installations. Arresters shall be of the metal-oxide varistor type.

#### 2.12 GROUNDING AND BONDING

##### 2.12.1 Driven Ground Rods

Ground rods shall be copper-clad steel conforming to UL 467 not less than 3/4 inch in diameter and 10 feet in length.

##### 2.12.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same material

as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B 8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

## 2.13 CONCRETE AND REINFORCEMENT

Concrete shall be a minimum of 2500 psi at 28 days. All other requirements shall be as specified in Section C-03300 CONCRETE FOR BUILDING CONSTRUCTION. Concrete reinforcing shall be as specified in Section C-03200 CONCRETE REINFORCEMENT.

## 2.14 PADLOCKS

Padlocks are provided under Section C-08700 BUILDER'S HARDWARE and specified on hardware schedule of architectural drawings.

## 2.15 CABLE FIREPROOFING SYSTEMS

Cable fireproofing systems shall be listed in FM P7825 as a fire-protective coating or tape approved for grouped electrical conductors and shall be suitable for application on the type of medium-voltage cables provided. After being fully cured, materials shall be suitable for use where exposed to oil, water, gases, salt water, sewage, and fungus and shall not damage cable jackets or insulation. Asbestos materials are not acceptable.

### 2.15.1 Fireproof Coating

Cable fireproofing coatings shall be compounded of water-based thermoplastic resins, flame-retardant chemicals, and inorganic noncombustible fibers and shall be suitable for the application methods used. Coatings applied on bundled cables shall have a derating factor of less than 5 percent, and a dielectric strength of 95 volts per mil minimum after curing. Coatings shall be seismically qualified in accordance with IEEE Std 344.

### 2.15.2 Fireproofing Tape

Fireproofing tape shall be at least 2 inches wide and shall be a flexible, conformable, polymeric, elastomer tape designed specifically for fireproofing cables.

### 2.15.3 Plastic Tape

Preapplication plastic tape shall be pressure sensitive, 10-mil thick, conforming to UL 510.

## 2.16 LIQUID DIELECTRICS

Liquid dielectrics for transformers, capacitors, reclosers, and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral-oil or less-flammable liquid as specified. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 trichlorobenzene fluids shall not be used. Liquid dielectrics in retrofitted equipment shall be certified by the manufacturer as having less than 50 parts per million (ppm) PCB content. In lieu of the manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D 923 and have tests performed per ASTM D 4059 at a testing facility approved by the Contracting Officer. Equipment with test results indicating PCB level exceeding 50 ppm shall be replaced.

## 2.17 FACTORY TESTS

Factory tests shall be performed, as follows, in accordance with the applicable publications and with other requirements of these specifications. The Contracting Officer shall be notified at least 10 days before the equipment is ready for testing. The Contracting Officer reserves the right to witness the tests.

a. Transformers: Manufacturer's standard routine tests in accordance with IEEE C57.12.00.

b. Transformers rated 200 kVA and above: Reduced full-wave, chopped-wave, and full-wave impulse test on each line and neutral terminal, in accordance with IEEE C57.98.

c. Electrical Power Insulators: Manufacturer's standard test in accordance with ANSI C29.1.

## 2.18 COORDINATED STUDY

Analyses shall be prepared to demonstrate that the equipment and system constructed meet the specified requirements for equipment ratings, coordination, and protection. They shall include a load flow analysis, a fault current analysis, and protective device coordination study. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last three years. The Contractor shall provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

### 2.18.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin at the source bus and extend down to system buses where fault availability is 10,000 amperes (symmetrical) for building/facility 600 volt level distribution buses.

### 2.18.2 Determination of Facts

The Contractor shall coordinate with the base power company for fault current availability at the site. The Contractor shall utilize the fault current availability indicated as a basis for fault current studies.

### 2.18.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current. A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance diagram is provide, impedance data shall be shown. Locations of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

### 2.18.4 Fault Current Analysis

#### 2.18.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE Std 242, and IEEE Std 399.

#### 2.18.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedances shall be those proposed. Data shall be documented in the report.

#### 2.18.4.3 Fault Current Availability

Balanced three-phase fault, bolted line-to-line fault, and line-to-ground fault current values shall be provided at each voltage transformation point and at each power distribution bus. The maximum and minimum values of fault available at each location shall be shown in tabular form on the diagram or in the report.

#### 2.18.5 Coordination Study

The study shall demonstrate that the maximum possible degree of selectivity has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. The study shall include a description of the coordination of the protective devices in this project. Provide a written narrative that describes: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situation where system coordination is not achievable due to device limitations (an analysis of any device curves which order overlap); coordination between upstream and downstream devices; and relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost changes (addition or reduction) shall be provided. Composite coordination plots shall be provided on log-log graph paper.

#### 2.18.6 Study Report

a. The report shall include a narrative: the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.

b. The study shall include descriptive and technical data for existing devices and new protective devices proposed. The data shall include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices.

c. The report shall document utility company data including system voltages, fault MVA, system X/R ratio, time-current characteristic curves, current transformer ratios, and relay device curves and protective device ratings and settings.

d. The report shall contain fully coordinated composite time-current characteristic curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. The report shall include recommended ratings and settings of all protective devices in tabulated form.

e. The report shall provide the calculations performed for the analyses, including computer analysis programs utilized. The name of the software package, developer, and version number shall be provided.

### 2.19 LAMPS AND BALLASTS, HIGH INTENSITY DISCHARGE (HID) SOURCES

#### 2.19.1 High-Pressure Sodium

Lamps shall conform to ANSI C78.1350. Ballasts shall conform to ANSI C82.4, or UL 1029. High-pressure sodium lamps shall be clear.

## 2.20 LUMINAIRE COMPONENTS

Luminaire components shall conform to the following: attachments, ANSI C136.3; voltage classification, ANSI C136.2; field identification marking, ANSI C136.15; interchangeability, ANSI C136.6 and ANSI C136.9; and sockets, ANSI C136.11.

## 2.21 LIGHTING CONTROL EQUIPMENT

### 2.21.1 Photo-Control Devices

Photo-control devices shall conform to ANSI C136.10. Each photo-control element shall be a replaceable, weatherproof, plug-in or twist-lock assembly adjustable operation range of approximately 0.5 to 5.0 foot-candles. Luminaires shall be equipped with weatherproof plug-in or twist-lock receptacle to receive the photo-control element.

## 2.22 LUMINAIRES, FLOODLIGHTING

### 2.22.1 HID

HID lighting fixtures shall conform to UL 1572.

## PART 3 EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of Section C-16415 ELECTRICAL WORK, INTERIOR. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section C-02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Concrete work shall conform to the requirements of Section C-03300 CONCRETE FOR BUILDING CONSTRUCTION.

#### 3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

#### 3.1.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

#### 3.1.3 NOT USED

### 3.2 CABLE AND BUSWAY INSTALLATION

The Contractor shall obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc.

### 3.2.1 Cable Installation Plan and Procedure

Cable shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information: cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

#### 3.2.1.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

#### 3.2.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 1/4 inch less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 8 cubic inches of debris is expelled from the duct.

#### 3.2.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

#### 3.2.1.4 Cable Installation

The Contractor shall provide a cable feeding truck and a cable pulling winch. The Contractor shall provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manilla rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. The Contractor shall not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 50 degrees F temperature for at least 24 hours before installation.

#### 3.2.1.5 NOT USED

### 3.2.2 Duct Line

Medium-voltage cables shall be installed in duct lines where indicated. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

### 3.2.3 Direct Burial

Low-voltage cables shall be buried directly in the earth as indicated. Minimum cover from the top of a cable to finished grade shall be 24 inches, but not less than the depth of the frost line.

#### 3.2.3.1 Trenching

Trenches for direct-burial cables shall be excavated to depths required to provide the minimum necessary cable cover. Bottoms of trenches shall be smooth and free of stones and sharp objects. Where bottoms of trenches comprise materials other than sand, a 3-inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil.

#### 3.2.3.2 Plowing

Cable plowing is not permitted.

#### 3.2.3.3 Cable Burial

Cables shall be unreeled along the sides of or in trenches and carefully placed on sand or earth bottoms. Pulling cables into direct-burial trenches from a fixed reel position will not be permitted, except as required to pull cables through conduits under paving or railroad tracks. Where cables cross, a separation of at least 3 inches shall be provided, unless each cable circuit is protected by a nonmetallic conduit sleeve at the crossing. Where single-conductor cable is installed, all 3 phases and the neutral shall be installed in the same sleeve. Bend radius of any cable shall be not less than 8 times the diameter of the cable. In no case shall cables be left under longitudinal tension. The first 6-inch layer of backfill shall be of sand. Machine compaction shall not be used within 6 inches of the cable.

#### 3.2.3.4 Other Requirements

Where direct-burial cables cross under roads or other paving exceeding 5 feet in width, such cables shall be installed in concrete-encased ducts. Where direct-burial cables cross under railroad tracks, such cables shall be installed in reinforced concrete-encased ducts. Ducts shall extend at least 1 foot beyond each edge of any paving and at least 5 feet beyond each side of any railroad tracks. Cables may be pulled into duct from a fixed reel where suitable rollers are provided in the trench. Where direct burial cable transitions to duct-enclosed cable, direct-burial cables shall be centered in duct entrances, and a waterproof nonhardening mastic compound shall be used to facilitate such centering. If paving or railroad tracks are in place where cables are to be installed, coated rigid steel conduits driven under the paving or railroad tracks may be used in lieu of concrete-encased ducts. Damage to conduit coatings shall be prevented by providing ferrous pipe jackets or by predrilling. Where cuts are made in any paving, the paving and subbase shall be restored to their original condition.

#### 3.2.3.5 Medium-Voltage Cable Joints or Low-Voltage Cable Splices

Cable joints or splices in direct-burial cables are not permitted in runs of 1000 feet or less, nor at intervals of less than 1000 feet in longer runs, except as required for taps. Locations of cable joints or splices in shorter intervals, where required to avoid obstructions or damage to cables, shall be approved. Cable joints or splices in direct burial installations shall be installed in above-ground junction boxes or in cast metal splice boxes suitable for direct burial use. Cable joints or splices in duct banks shall be made only in manholes, handholes, or pullboxes.

#### 3.2.3.6 Cable Markers

Brightly colored, 5 mil plastic tape not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers, with a continuous metallic backing and a corrosion resistance 1 mil metallic foil core to permit easy location of this duct line, shall be placed approximately 12 inches below finished grade levels of trenches.



#### 3.2.4 NOT USED

#### 3.2.5 Electric Manholes

Cables shall be routed around the interior walls and securely supported from walls on cables racks. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of additional cables, and maintain cable separation in accordance with IEEE C2.

#### 3.2.6 NOT USED

### 3.3 CABLE JOINTS

Medium-voltage cable joints shall be made by qualified cable splicers only. Qualifications of cable splicers shall be submitted in accordance with paragraph SUBMITTALS.

Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of preformed joints. Shields shall be grounded at each joint or in accordance with manufacturer's recommended practice. Cable joints shall provide insulation and jacket equivalent to that of the associated cable.

### 3.4 FIREPROOFING

Each medium-voltage cable and conductor in manholes shall be fire-proofed for their entire length within the manhole. Where cables and conductors have been lubricated to enhance pulling into ducts, the lubricant shall be removed from cables and conductors exposed in the manhole before fireproofing. Fire-stops shall be installed in each conduit entering or leaving a manhole.

#### 3.4.1 Tape Method

Before application of fireproofing tape, plastic tape wrapping shall be applied over exposed metallic items such as the cable ground wire, metallic outer covering, or armor to minimize the possibility of corrosion from the fireproofing materials and moisture. Before applying fireproofing tape, irregularities of cables, such as at cable joints, shall be evened out with insulation putty. A flexible conformable polymeric elastomer fireproof tape shall be wrapped tightly around each cable spirally in 1/2 lapped wrapping or in 2 butt-jointed wrappings with the second wrapping covering the joints of the first.

#### 3.4.2 Sprayable Method

Manholes shall be power ventilated until coatings are dry and dewatered and the coatings are cured. Ventilation requirements shall be in accordance with the manufacturer's instruction, but not less than 10 air changes per hour shall be provided. Cable coatings shall be applied by spray, brush, or glove to a wet film thickness that reduces to the dry film thickness approved for fireproofing by FM P7825. Application methods and necessary safety precautions shall be in accordance with the manufacturers instructions. After application, cable coatings shall be dry to the touch in 1 to 2 hours and fully cured in 48 hours, except where the manufacturer has stated that because of unusual humidity or temperature, longer periods may be necessary.

### 3.5 DUCT LINES

#### 3.5.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3-inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

#### 3.5.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

#### 3.5.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. Each single duct requiring concrete encasement shall be completely encased in concrete with a minimum of 3 inches of concrete around each duct, except that only 2 inches of concrete are required between adjacent electric power or adjacent communication ducts, and 4 inches of concrete shall be provided between adjacent electric power and communication ducts. Duct line encasements shall be monolithic construction. At any point, tops of concrete encasements shall be not less than the cover requirements listed in NFPA 70. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 6 inches vertically.

#### 3.5.4 Nonencased Direct-Burial

Top of duct lines shall be below the frost line depth of not less than 24 inches below finished grade and shall be installed with a minimum of 3 inches of earth around each duct, except that between adjacent electric power and communication ducts, 12 inches of earth is required. Bottoms of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand, a 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts. Joints in adjacent tiers of duct shall be vertically staggered at least 6 inches. The first 6-inch layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 3-to 6-inch layers. Duct banks may be held in alignment with earth. However, high-tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling.

#### 3.5.5 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

#### 3.5.5.1 NOT USED

#### 3.5.5.2 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

#### 3.5.6 Duct Line Markers

Brightly colored plastic tape, not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion-resistant 1 mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches below finished grade levels of such lines.

### 3.6 MANHOLES

#### 3.6.1 General

Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of each manhole shall be approved by the Contracting Officer before construction of the manhole is started. Manholes shall be the type noted on the drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may at his option utilize monolithically constructed precast-concrete manholes having the required strength and inside dimensions as required by the drawings or specifications. Frames and covers shall be delivered on the job unpainted and, after approval, shall be given 2 coats of asphalt paint. In paved areas, frames and covers for manhole and handhole entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 1/2 inch above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. Where duct lines enter manholes, the sections of duct may be either cast in the concrete or may enter the manhole through a square or rectangular opening of suitable dimensions provided in the manhole walls. Where openings are provided for the entrance of duct lines, the space between ducts and between ducts and manhole walls shall be caulked tight with lead wool or approved equal. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

#### 3.6.2 Electric Manholes

Cables shall be securely supported from walls by hot-dip galvanized cable racks with a plastic coating over the galvanizing and equipped with adjustable hooks and insulators. The number of cable racks indicated shall be installed in each manhole and not less than 2 spare hooks shall be installed on each cable rack. Insulators shall be made of high-glazed porcelain. Insulators will not be required on spare hooks.

### 3.6.3 Communications Manholes

The number of hot-dip galvanized cable racks with a plastic coating over the galvanizing indicated shall be installed in each telephone manhole. Each cable rack shall be provided with 2 cable hooks. Cables for the telephone and communication systems will be installed by others.

### 3.6.4 NOT USED

### 3.6.5 NOT USED

### 3.6.6 Ground Rods

A ground rod shall be installed at the manholes, handholes and pullboxes. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 4 inches of the ground rod will extend above the manhole floor. When precast concrete manholes are used, the top of the ground rod may be below the manhole floor and a No. 1/0 AWG tinned ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

## 3.7 PAD-MOUNTED EQUIPMENT INSTALLATION

Pad-mounted equipment, shall be installed on concrete pads in accordance with the manufacturers published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be carefully installed so as not to damage equipment or scratch painted or coated surfaces. After installation, surfaces shall be inspected and scratches touched up with a paint or coating provided by the manufacturer especially for this purpose.

### 3.7.1 Concrete Pads

#### 3.7.1.1 Construction

Concrete pads for pad-mounted electrical equipment shall be poured-in-place. Pads shall be constructed as indicated except that exact pad dimensions and mounting details are equipment specific and are the responsibility of the Contractor. Tops of concrete pads shall be level and shall project 4 inches above finished paving or grade and sloped to drain. Edges of concrete pads shall have 3/4 inch chamfer. Conduits for primary, secondary, and grounding conductors shall be set in place prior to placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be provided with a rectangular hole below the primary and secondary compartments, sized in accordance with the manufacturer's recommended dimensions. Upon completion of equipment installation the rectangular hole shall be filled with masonry grout.

#### 3.7.1.2 Concrete and Reinforcement

Concrete work shall comply with the requirements of Section C-03300 CONCRETE FOR BUILDING CONSTRUCTION. Concrete pad reinforcement shall be in accordance with Section C-03200 CONCRETE REINFORCEMENT.

#### 3.7.1.3 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

#### 3.7.2 Padlocks

Padlocks shall be provided for pad-mounted equipment as indicated on hardware schedule of architectural drawings. Padlocks shall be Best Lock and delivered directly to DPW locksmith for keying.

#### 3.7.3 NOT USED

### 3.8 CONNECTIONS BETWEEN AERIAL AND UNDERGROUND SYSTEMS

Connections between aerial and underground systems shall be made as shown. Underground cables shall be extended up poles in conduit to cable terminations. Conduits shall be secured to the poles by 2-hole galvanized steel pipe straps spaced not more than 10 feet apart and with 1 strap not more than 12 inches from any bend or termination. Cable guards shall be secured to poles in accordance with the manufacturer's published procedures. Conduits shall be equipped with bushings to protect cables and minimize water entry. Capnut potheads shall be used to terminate medium-voltage multiple-conductor cable. Cables shall be supported by devices separate from the conduit or guard, near their point of exit from the conduit or guard.

#### 3.8.1 NOT USED

### 3.9 CONNECTIONS TO BUILDINGS

Cables shall be extended into the various buildings as indicated, and shall be connected to the first applicable termination point in each building. Interfacing with building interior conduit systems shall be at conduit stubouts terminating 5 feet outside of a building and 2 feet below finished grade as specified and provided under Section C-16415 ELECTRICAL WORK, INTERIOR. After installation of cables, conduits shall be sealed with caulking compound to prevent entrance of moisture or gases into buildings.

### 3.10 GROUNDING

A ground ring consisting of the indicated configuration of bare copper conductors and driven ground rods shall be installed around pad-mounted equipment as shown. Equipment frames of metal-enclosed equipment, and other noncurrent-carrying metal parts, such as cable shields, cable sheaths and armor, and metallic conduit shall be grounded. At least 2 connections shall be provided from a transformer to the ground ring.

#### 3.10.1 Grounding Electrodes

Grounding electrodes shall be installed as shown on the drawings and as follows:

- a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be driven into the earth until the tops of the rods are approximately 1 foot below finished grade.
- b. Ground ring - A ground ring shall be installed as shown consisting of bare copper conductors installed 24 inches, plus or minus below finished top of soil grade. Ground ring conductors shall be

sized as shown.

- c. Additional electrodes - Whenever the required ground resistance is not met, provide additional electrodes interconnected with grounding conductors, to achieve the specified ground resistance. The additional electrodes will be up to 3, 10-foot rods spaced a minimum of 10 feet apart.

#### 3.10.2 Grounding and Bonding Connections

Connections above grade shall be made with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process.

#### 3.10.3 Grounding and Bonding Conductors

Grounding and bonding conductors include all conductors used to bond transformer enclosures and equipment frames to the grounding electrode system. Grounding and bonding conductors shall be sized as shown, and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

#### 3.10.4 Surge Arrester Grounding

Surge arresters and neutrals shall be bonded directly to the transformer enclosure and then to the grounding electrode system with a bare copper conductor, sized as shown. Lead lengths shall be kept as short as practicable with no kinks or sharp bends.

#### 3.10.5 Manhole Grounding

Ground rods installed in electrical-distribution-system manholes, handholes, or concrete pullboxes shall be connected to cable racks, cable-pulling irons, the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a No. 4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 2 inches above and 6 inches below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.

#### 3.10.6 NOT USED

#### 3.10.7 NOT USED

### 3.11 FIELD TESTING

#### 3.11.1 General

Field testing shall be performed in the presence of the Contracting Officer. The contractor shall notify the Contracting Officer 7 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. All field test reports shall be signed and dated by the Contractor.

#### 3.11.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

#### 3.11.3 Ground-Resistance Tests

The resistance of the ground ring shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

- a. Ground ring - 5 ohms.

#### 3.11.4 Ground-Ring Connection Inspection

All below-grade ground-ring connections will be visually inspected by the Contracting Officer before backfilling. The Contractor shall notify the Contracting Officer 24 hours before the site is ready for inspection.

#### 3.11.5 Medium-Voltage Cable Test

After installation and before the operating test or connection to an existing system, the medium-voltage cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shieldings or sheaths of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The test shall be conducted with all splices, connectors, and terminations in place. The method, voltage, length of time, and other characteristics of the test for initial installation shall be in accordance with NEMA WC 7 or NEMA WC 8 for the particular type of cable installed, except that 28 kV and 35 kV insulation test voltages shall be in accordance with either AEIC CS5 or AEIC CS6 as applicable, and shall not exceed the recommendations of IEEE Std 404 for cable joints and IEEE Std 48 for cable terminations unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or

other connections, the Contractor shall make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

3.11.6 NOT USED

3.11.7 NOT USED

3.11.8 NOT USED

3.11.9 NOT USED

3.11.10 NOT USED

3.11.11 NOT USED

3.11.12 Pre-Energization Services

Calibration, testing, adjustment, and placing into service of the installation shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of 2 years of current product experience. The following services shall be performed on the equipment listed below. These services shall be performed subsequent to testing but prior to the initial energization. The equipment shall be inspected to ensure that installation is in compliance with the recommendations of the manufacturer and as shown on the detail drawings. Terminations of conductors at major equipment shall be inspected to ensure the adequacy of connections. Bare and insulated conductors between such terminations shall be inspected to detect possible damage during installation. If factory tests were not performed on completed assemblies, tests shall be performed after the installation of completed assemblies. Components shall be inspected for damage caused during installation or shipment to ensure packaging materials have been removed. Components capable of being both manually and electrically operated shall be operated manually prior to the first electrical operation. Components capable of being calibrated, adjusted, and tested shall be calibrated, adjusted, and tested in accordance with the instructions of the equipment manufacturer. Items for which such services shall be provided, but are not limited to, are the following:

- a. Pad-mounted transformers
- b. Panelboards
- c. Switchboards
- d. Switches

3.11.13 Operating Tests

After the installation is completed, and at such times as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the requirements herein. An operating test report shall be submitted in accordance with SUBMITTALS Test Reports.



### 3.12 LIGHTING

#### 3.12.1 Floodlights

Floodlights shall be of the enclosed heavy-duty type having indicated beam spreads and adjustable support brackets suitable for required mountings. Where indicated, floodlights shall be equipped with weather-proof plug-in or twist-lock receptacles to receive photo-control elements. Lamps shall be of the sizes and types indicated and provided with appropriate ballasts.

#### 3.12.2 NOT USED

#### 3.12.3 Vandal-Resistant Construction

Where indicated, luminaires shall be provided with vandal-resistant construction. Exposed diffusers, reflectors, or refractors shall be of a polycarbonate resin, except that other material may be used if protected by a polycarbonate resin shield or cast metal guard. Luminaires mounted 15 feet and less above grade shall have exposed screws of the tamper-resistant type.

#### 3.12.4 Photo-Control

Where indicated, luminaires shall be individually controlled by a photo-control element mounted on the luminaire. Each photo-control element shall have an adjustable operating range of approximately 0.5 to 5.0 footcandles and shall be mounted in a replaceable, weatherproof, plug-in or twist-lock assembly.

#### 3.12.5 NOT USED

#### 3.12.6 Poles

Lighting poles shall be a nominal 30 feet in length, round and tapered steel (non-painted). Poles shall be suitable for use with underground supply conductors. Poles shall be designed for a wind velocity of 70 mph at the base of the pole, for a wind gust factor of 1.3, and for the height and drag factors recommended by AASHTO LTS-2. The effective projected area of luminaires and other pole-mounted devices shall be taken into account in pole design. Poles shall have grounding provisions. Bases shall be of the anchor-bolt-mounted type. The type of pole shaft material provided shall not be mixed on any project.

##### 3.12.6.1 Brackets

Brackets for area lighting shall be of the indicated types. Brackets for floodlights shall have the number of tenons indicated. Brackets for roadway luminaires shall correctly position luminaires not less than 4 feet from poles, at not less than the mounting heights indicated, but in no case less than 24 feet above any roadway. Slip-fitter brackets shall be coordinated with the luminaires provided, and brackets used with one type of luminaire shall be identical. Brackets shall be not less than 1-1/4 inch galvanized steel pipe or equivalent aluminum. On metal poles, brackets shall be of the same metal.

##### 3.12.6.2 NOT USED

##### 3.12.6.3 Steel Poles

Steel poles and steel brackets shall be hot-dip galvanized in accordance with ASTM A 123 and shall not be painted.

##### 3.12.6.4 NOT USED

#### 3.12.6.5 Pole Setting

Poles shall be mounted on cast-in-place foundations. Where indicated, concrete poles shall be embedded in accordance with the details shown. Conduit ells shall be provided for cable entrances into pole interiors.

a. Cast-In-Place Foundations: Concrete foundations, sized as indicated, shall have anchor bolts accurately set in foundations using templates supplied by the pole manufacturer. After the concrete has cured, pole anchor bases shall be set on foundations and leveled by shimming between anchor bases and foundations or by setting anchor bases on leveling nuts and grouting. Poles shall be set plumb. Anchor bolts shall be the manufacturers' standard, and not less than necessary to meet the pole wind loading specified herein and other design requirements.

#### 3.13 ACCEPTANCE

Final acceptance of the facility will not be given until the contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

SECTION C-16415

ELECTRICAL WORK, INTERIOR

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	(1995) Code for Electricity Metering
ANSI C12.10	(1987) Electromechanical Watthour Meters
ANSI C37.16	(1988; C37.16a; R 1995) Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations
ANSI C39.1	(1981; R 1992) Requirements for Electrical Analog Indicating Instruments
ANSI C57.12.10	(1987) Safety Requirements for Transformers 230 kV and Below 833/958 Through 8333/10417 kVA, Single-Phase, and 750/862 Through 60 000/80 000/100 000 kVA, Three-Phase Without Load Tap Charging; and 3750/4687 Through 60 000/80 000/100 000 kVA With Load Tap Charging
ANSI C57.12.50	(1981; R 1989) Ventilated Dry-type Distribution Transformers 1 to 500 kVA, Single-Phase; and 15 to 500 kVA, Three-Phase with High-Voltage 601 to 34 500 Volts, Low-Voltage 120 to 600 Volts
ANSI C57.12.70	(1978; R 1993) Terminal Markings and Connections for Distribution and Power Transformers
ANSI C82.1	(1985; C82.1a; C82.1b; C82.1c; R 1992) Specifications for Fluorescent Lamp Ballasts
ANSI C82.4	(1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(1990) Hard-Drawn Copper Wire
ASTM B 8	(1993) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 709	(1992) Laminated Thermosetting Materials
ASTM D 4059	(1991) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography

CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 18	Industrial, Scientific, and Medical Equipment
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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE C37.13	(1990; R 1995) Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.20.1	(1993) Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE C57.12.00	(1993) IEEE Standard General Requirements for Liquid -Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.80	(1978; R 1992) Terminology for Power and Distribution Transformers
IEEE C57.12.90	(1993) Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and Guide for Short- Circuit Testing of Distribution and Power Transformers
IEEE ANSI/IEEE C57.13	(1993) Instrument Transformers
IEEE C57.98	(1993) Guide for Transformer Impulse Tests
IEEE C57.100	(1986; R 1992) Test Procedure for Thermal Evaluation of Oil-Immersed Distribution Transformers
IEEE C62.41	(1991) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)
IEEE Std 242	(1986; R 1991) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE Std 399	(1990) Recommended Practice for Industrial and Commercial Power Systems Analysis

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, Overload Relays Rated Not More Than 2,000 Volts AC or 750 DC
NEMA ICS 3	(1993) Industrial Control and Systems Factory Built Assemblies

NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA LE 4	(1987) Recessed Luminaires, Ceiling Compatibility
NEMA MG 1	(1993; Rev 1; Rev 2; Rev 3) Motors and Generators
NEMA MG 10	(1994) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA OS 1	(1989) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA OS 2	(1986; Errata Aug 1986; R 1991) Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
NEMA PB 1	(1990) Panelboards
NEMA PB 2	(1995) Deadfront Distribution Switchboards
NEMA SG 3	(1995) Low-Voltage Power Circuit Breakers
NEMA ST 20	(1992) Dry-Type Transformers for General Applications
NEMA TC 2	(1990) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA WD 1	(1983; R 1989) General Requirements for Wiring Devices
NEMA WD 6	(1988) Wiring Devices - Dimensional Requirements

#### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996) National Electrical Code
NFPA 101	(1997) Safety to Life from Fire in Buildings and Structures

#### UNDERWRITERS LABORATORIES (UL)

UL-03	(1996; Supple) Electrical Construction Materials Directory
UL 1	(1993; Rev thru Jan 1995) Flexible Metal Conduit
UL 5	(1995) Surface Metal Raceways and Fittings
UL 6	(1993; Rev Mar 1996) Rigid Metal Conduit
UL 20	(1995; Rev thru Apr 1997) General-Use Snap Switches
UL 44	(1997) Thermoset-Insulated Wires and Cables
UL 50	(1995; Rev Oct 1996) Enclosures for Electrical Equipment
UL 67	(1993; Rev thru Dec 1993) Panelboards
UL 83	(1996) Thermoplastic-Insulated Wires and Cables
UL 98	(1994; R Oct 1995) Enclosed and Dead-Front Switches

UL 198B	(1995) Class H Fuses
UL 198C	(1986; Rev thru Jun 1993) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198D	(1995) Class K Fuses
UL 198E	(1988; Rev Jul 1988) Class R Fuses
UL 198G	(1988; Rev May 1988) Fuses for Supplementary Overcurrent Protection
UL 360	(1996; Rev Mar 1997) Liquid-Tight Flexible Steel Conduit
UL 467	(1993; Rev thru Aug 1996) Grounding and Bonding Equipment
UL 486A	(1991; Rev Oct 1991) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486C	(1997) Splicing Wire Connectors
UL 486E	(1994; Rev thru Feb 1997) Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
UL 489	(1996; Rev May 1997) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 498	(1996) Attachment Plugs and Receptacles
UL 508	(1993) Industrial Control Equipment
UL 510	(1994) Insulating Tape
UL 512	(1993; R Dec 1995) Fuseholders
UL 514A	(1996) Metallic Outlet Boxes
UL 514B	(1996) Fittings for Conduit and Outlet Boxes
UL 542	(1994; Rev May 1997) Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 651	(1995; Rev Jan 1997) Schedule 40 and 80 Rigid PVC Conduit
UL 674	(1994; Rev thru Feb 1997) Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 698	(1995; Rev thru Dec 1996) Industrial Control Equipment for Use in Hazardous (Classified) Locations
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 817	(1994; Rev thru Feb 1997) Cord Sets and Power-Supply Cords
UL 844	(1995; Rev thru Aug 1996) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations

UL 845	(1995; Rev Feb 1996) Motor Control Centers
UL 854	(1996; Rev May 1996) Service-Entrance Cables
UL 869A	(1993; Rev Apr 1994) Reference Standard for Service Equipment
UL 877	(1993; Rev Jul 1995) Circuit Breakers and Circuit -Breaker Enclosures for Use in Hazardous (Classified) Locations
UL 886	(1994; Rev thru Jan 1997) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 891	(1994; Rev thru Jan 1995) Dead-Front Switchboards
UL 924	(1995; Rev thru May 95) Emergency Lighting and Power Equipment
UL 935	(1995; Rev thru Apr 1997)Fluorescent-Lamp Ballasts
UL 943	(1993; Rev thru Mar 1997)Ground-Fault Circuit Interrupters
UL 1004	(1994; Rev thru Feb 1997) Electric Motors
UL 1010	(1995; Rev thru Dec 1996)Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations
UL 1029	(1994; Rev Sep 1995) High-Intensity-Discharge Lamp Ballasts
UL 1242	(1996) Intermediate Metal Conduit
UL 1449	(1985; Errata Apr 1986) Transient Voltage Surge Suppressors
UL 1570	(1995) Fluorescent Lighting Fixtures
UL 1571	(1991; Rev thru Mar 95) Incandescent Lighting Fixtures
UL 1572	(1995; Rev thru Sep 96) High Intensity Discharge Lighting Fixtures
UL 1660	(1994) Liquid-Tight Flexible Nonmetallic Conduit

## 1.2 GENERAL

### 1.2.1 Rules

The installation shall conform to the requirements of NFPA 70 and NFPA 101, unless more stringent requirements are indicated herein or shown.

### 1.2.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment shall be properly located and readily accessible. Lighting fixtures, outlets, and other equipment and materials shall be located to avoid interference with mechanical or structural features; otherwise, lighting fixtures

shall be symmetrically located according to the room arrangement when uniform illumination is required, or asymmetrically located to suit conditions fixed by design and shown. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. The Contractor shall coordinate electrical work with the HVAC and electrical drawings and specifications and provide power related wiring.

### 1.2.3 Special Environments

#### 1.2.3.1 Weatherproof Locations

Wiring, Fixtures, and equipment in designated locations shall conform to NFPA 70 requirements for installation in damp or wet locations.

#### 1.2.3.2 Hazardous Locations

Wiring in locations indicated shall conform to the NFPA 70 for Class I Division 2 hazardous locations. Equipment shall be suitable for Group D. Wiring and equipment in locations indicated shall be of the classes, groups, divisions, and suitable for the operating temperature; as indicated.

#### 1.2.3.3 Ducts, Plenums and Other Air-Handling Spaces

Wiring and equipment in ducts, plenums and other air-handling spaces shall be installed using materials and methods in conformance with NFPA 70 unless more stringent requirements are indicated in this specification or on the contract drawings.

### 1.2.4 Standard Products

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

### 1.2.5 NAMEPLATES

#### 1.2.5.1 Identification Nameplates

Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Designation of motors shall coincide with their designation in the motor control center or panel. Unless otherwise specified, identification nameplates shall be made of laminated plastic in accordance with ASTM D 709 with black outer layers and a white core. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws, except motors, or approved nonadhesive metal fasteners. When the nameplate is to be installed on an irregular-shaped object, the Contractor shall devise an approved support suitable for the application and ensure the proper installation of the supports and nameplates. In all instances, the nameplate shall be installed in a conspicuous location. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The front of each panelboard, motor control center, switchgear, and switchboard shall have a nameplate to indicate the phase letter, corresponding color and arrangement of the phase conductors. The following equipment, as a minimum, shall be provided with identification nameplates:



Minimum 1/4 inch  
High Letters

Minimum 1/8 inch  
High Letters

Panelboards  
Starters  
Safety Switches  
Motor Control Centers  
Transformers  
Equipment Enclosures  
Switchgear  
Switchboards  
Motors

Control Power Transformers  
Control Devices  
Instrument Transformers

Each panel, section, or unit in motor control centers, switchgear or similar assemblies shall be provided with a nameplate in addition to nameplates listed above, which shall be provided for individual compartments in the respective assembly, including nameplates which identify "future," "spare," and "dedicated" or "equipped spaces."

#### 1.2.5.2 NOT USED

#### 1.2.6 As-Built Drawings

Following the project completion or turnover, within 30 days the Contractor shall furnish two sets of as-built drawings to the Contracting Officer.

#### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-01 Data

Fault Current and Protective Device Coordination Study; FIO.

The study shall be submitted along with protective device equipment submittals. No time extensions or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed shall be based on recommendations of this study. The Government shall not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study.

Manufacturer's Catalog; FIO.

Data composed of catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists; FIO.

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each item.

Installation Procedures; FIO.

Installation procedures for rotating equipment, transformers, switchgear, battery systems, voltage regulators, and grounding resistors. Procedures shall include

diagrams, instructions, and precautions required to install, adjust, calibrate, and test devices and equipment.

#### SD-04 Drawings

##### Interior Electrical Equipment; GA.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams, and other information necessary to define the installation. Detail drawings shall show the rating of items and systems and how the components of an item and system are assembled, function together, and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall show physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Optional items shall be clearly identified as included or excluded. Detail drawings shall as a minimum include:

- a. Transformers.
- b. Switchboards.
- c. Circuit breakers.
- d. Fixtures, lighting and fixture accessories.
- e. Panelboards and load centers.
- f. Service equipment.
- g. Motor control centers.
- h. Single line electrical diagrams including primary, metering, sensing and relaying, control wiring, and control logic.

Electrical drawings including single-line and three-line diagrams, and schematics or elementary diagrams of each electrical system; internal wiring and field connection diagrams of each electrical device when published by the manufacturer; wiring diagrams of cabinets, panels, units, or separate mountings; interconnection diagrams that show the wiring between separate components of assemblies; field connection diagrams that show the termination of wiring routed between separate items of equipment; internal wiring diagrams of equipment showing wiring as actually provided for this project. Field wiring connections shall be clearly identified.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures, including changes in related portions of the project and the reasons why, shall be submitted with the detail drawings. Approved departures shall be made at no additional cost to the Government.

##### As-Built Drawings; FIO.

The as-built drawings shall be a record of the construction as installed. The drawings shall include all the information shown on the contract drawings,

deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be kept at the job site and updated daily. The as-built drawings shall be a full-sized set of prints marked to reflect all deviations, changes, and modifications. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall submit three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within ten calendar days from the time the drawings are returned to the Contractor.

#### SD-08 Statements

On-Site Test; GA.

A detailed description of the Contractor's proposed procedures for on-site tests.

#### SD-09 Reports

Factory Test Reports; GA.

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

- a. A list of equipment used, with calibration certifications.
- b. A copy of measurements taken.
- c. The dates of testing.
- d. The equipment and values to be verified.
- e. The conditions specified for the test.
- f. The test results, signed and dated.
- g. A description of adjustments made.

Field Test Plan; GA.

A detailed description of the Contractor's proposed procedures for on-site test submitted 30 days prior to testing the installed system. No field test will be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Field Test Reports; GA.

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

- a. A list of equipment used, with calibration certifications.

- b. A copy of measurements taken.
- c. The dates of testing.
- d. The equipment and values to be verified.
- e. The conditions specified for the test.
- f. The test results, signed and dated.
- g. A description of adjustments made.
- h. Final position of controls and device settings.

#### SD-13 Certificates

#### Materials and Equipment; GA.

The label or listing of the Underwriters Laboratories, Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer. Items which are required to be listed and labeled in accordance with Underwriters Laboratories must be affixed with a UL label that states that it is UL listed. No exceptions or waivers will be granted to this requirement. Materials and equipment will be approved based on the manufacturer's published data.

For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable.

#### 1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with NFPA 70, recommendations of the manufacturer, and as shown.

#### PART 2 PRODUCTS

Products shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

##### 2.1 NOT USED

##### 2.2 CABLES AND WIRES

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

##### 2.2.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to meet manufacturer's requirements.

#### 2.2.2 Aluminum Conductors

Aluminum conductors shall not be used.

#### 2.2.3 Insulation

Unless indicated otherwise, or required by NFPA 70, power and lighting wires shall be 600-volt, Type THHN/THWN conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW, THW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

#### 2.2.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

#### 2.2.5 NOT USED

#### 2.2.6 NOT USED

#### 2.2.7 NOT USED

#### 2.2.8 NOT USED

#### 2.2.9 NOT USED

#### 2.2.10 NOT USED

#### 2.2.11 NOT USED

#### 2.2.12 Cord Sets and Power-Supply Cords

UL 817.

#### 2.3 NOT USED

#### 2.4 TRANSIENT VOLTAGE SURGE PROTECTION

Transient voltage surge suppressors shall be provided as indicated. Surge suppressors shall meet the requirements of IEEE C62.41 and be UL listed and labeled as having been tested in accordance with UL 1449. Surge suppressor ratings shall be 120/208 volts rms, operating voltage; 60 Hz; 3-phase; 4 wire with ground; transient suppression voltage (peak let-through voltage) of 420 volts. Fuses shall not be used as surge suppression.

Surge suppressor shall have the following:

- a. maximum surge capability of 80 kA per phase.
- b. protective mode: L-N, L-G, L-L, N-G
- c. provide proper fusing to prevent catastrophic failure
- d. suitable for Class C3 location as defined in IEEE C62.41.

#### 2.5 NOT USED

## 2.6 CIRCUIT BREAKERS

### 2.6.1 MOLDED-CASE CIRCUIT BREAKERS

Molded-case circuit breakers shall conform to NEMA AB 1 and UL 489 for circuit breakers and circuit breaker enclosures. Circuit breakers may be installed in panelboards, switchboards, enclosures, motor control centers, or combination motor controllers.

#### 2.6.1.1 Construction

Circuit breakers shall be suitable for mounting and operating in any position. Lug shall be listed for copper conductors only in accordance with UL 486E. Single-pole circuit breakers shall be full module size with not more than one pole per module. Multi-pole circuit breakers shall be of the common-trip type having a single operating handle such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multi-pole unit having an internal, mechanical, nontamperable common-trip mechanism and external handle ties. All circuit breakers shall have a quick-make, quick-break overcenter toggle-type mechanism, and the handle mechanism shall be trip-free to prevent holding the contacts closed against a short-circuit or sustained overload. All circuit breaker handles shall assume a position between "ON" and "OFF" when tripped automatically. All ratings shall be clearly visible.

#### 2.6.1.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. The interrupting rating of the circuit breakers shall be at least equal to the available short-circuit current at the line terminals of the circuit breaker and correspond to the UL listed integrated short-circuit current rating specified for the panelboards and switchboards. Molded-case circuit breakers shall have nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings in accordance with NEMA AB 1. Ratings shall be coordinated with system X/R ratio.

#### 2.6.1.3 NOT USED

#### 2.6.1.4 Thermal-Magnetic Trip Elements

Thermal magnetic circuit breakers shall be provided as shown. Automatic operation shall be obtained by means of thermal-magnetic tripping devices located in each pole providing inverse time delay and instantaneous circuit protection. The instantaneous magnetic trip shall be adjustable and accessible from the front of all circuit breakers on frame sizes above 150 amperes.

### 2.6.2 Solid-State Trip Elements

Solid-state circuit breakers shall be provided in switchboards as shown. All electronics shall be self-contained and require no external relaying, power supply, or accessories. Printed circuit cards shall be treated to resist moisture absorption, fungus growth, and signal leakage. All electronics shall be housed in an enclosure which provides protection against arcs, magnetic interference, dust, and other contaminants. Solid-state sensing shall measure true RMS current with error less than one percent on systems with distortions through the 13th harmonic. Peak or average actuating devices are not acceptable. Current sensors shall be torodial construction, encased in a plastic housing filled with epoxy to protect against damage and moisture and shall be integrally mounted on the breaker. Where indicated on the drawings, circuit breaker frames

shall be rated for 100 percent continuous duty. Circuit breakers shall have tripping features as shown on the drawings and as described below:

- a. Long-time current pick-up, adjustable from 50 percent to 100 percent of continuous current rating.
- b. Adjustable long-time delay.
- c. Short-time current pick-up, adjustable from 1.5 to 9 times long-time current setting.
- d. Adjustable short-time delay.
- e. Instantaneous current pick-up, adjustable from 1.5 to 9 times long-time current setting.
- f. Ground-fault pick-up (for main only), adjustable from 20 percent to 60 percent of sensor rating, but in no case greater than 1200 amperes. Sensing of ground-fault current at the main bonding jumper or ground strap shall not be permitted.
- g. Adjustable ground-fault delay.
- i. Overload, short-time and ground-fault trip indicators shall be provided.

#### 2.6.3 NOT USED

#### 2.6.4 SWD Circuit Breakers

Circuit breakers rated 15 amperes and intended to switch 277 volts or less fluorescent lighting loads shall be marked "SWD."

#### 2.6.5 HACR Circuit Breakers

Circuit breakers 60 amperes or below, 240 volts, 1-pole or 2-pole, intended to protect multi-motor and combination-load installations involved in heating, air conditioning, and refrigerating equipment shall be marked "Listed HACR Type."

#### 2.6.6 NOT USED

#### 2.6.7 NOT USED

#### 2.6.8 Ground Fault Circuit Interrupters

UL 943. Breakers equipped with ground fault circuit interrupters shall have ground fault class, interrupting capacity, and voltage and current ratings as indicated.

### 2.7 MOTOR SHORT-CIRCUIT PROTECTOR (MSCP)

Motor short-circuit protectors shall conform to UL 508 and shall be provided as shown. Protectors shall be used only as part of a combination motor controller which provides coordinated motor branch-circuit overload and short-circuit protection, and shall be rated in accordance with the requirements of NFPA 70.

#### 2.7.1 Construction

Motor short-circuit protector bodies shall be constructed of high temperature, dimensionally stable, long life, nonhygroscopic materials. Protectors shall fit special MSCP mounting clips and shall not be interchangeable with any commercially available fuses. Protectors shall have 100 percent one-way

interchangeability within the A-Y letter designations. All ratings shall be clearly visible.

#### 2.7.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Letter designations shall be A through Y for motor controller Sizes 0, 1, 2, 3, 4, and 5, with 100,000 amperes interrupting capacity rating. Letter designations shall correspond to controller sizes as follows:

CONTROLLER SIZE	MSCP DESIGNATION
NEMA 0	A-N
NEMA 1	A-P
NEMA 2	A-S
NEMA 3	A-U
NEMA 4	A-W
NEMA 5	A-Y

#### 2.8 CONDUIT AND TUBING

##### 2.8.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797

##### 2.8.2 NOT USED

##### 2.8.3 NOT USED

##### 2.8.4 Flexible Conduit, Steel and Plastic

General-purpose type, UL 1; liquid tight, UL 360, and UL 1660.

##### 2.8.5 Intermediate Metal Conduit

UL 1242.

##### 2.8.6 NOT USED

##### 2.8.7 NOT USED

##### 2.8.8 Rigid Metal Conduit

UL 6.

##### 2.8.9 NOT USED

##### 2.8.10 Surface Metal Electrical Raceways and Fittings

UL 5.

#### 2.9 CONDUIT AND DEVICE BOXES AND FITTINGS

##### 2.9.1 Boxes, Metallic Outlet

NEMA OS 1 and UL 514C.



2.9.2 NOT USED

2.9.3 Boxes, Outlet for Use in Hazardous (Classified) Locations

UL 886.

2.9.4 Boxes, Switch (Enclosed), Surface-Mounted

UL 98.

2.9.5 Fittings for Conduit and Outlet Boxes

UL 514B.

2.9.6 Fittings For Use in Hazardous (Classified) Locations

UL 886.

2.9.7 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.10 NOT USED

2.11 CONNECTORS, WIRE PRESSURE

2.11.1 For Use With Copper Conductors

UL 486A.

2.11.2 NOT USED

2.12 ELECTRICAL GROUNDING AND BONDING EQUIPMENT

UL 467.

2.12.1 Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 not less than 3/4 inch in diameter by 10 feet in length of the sectional type driven full length into the earth.

2.12.2 Ground Bus

The ground bus shall be bare conductor or flat copper in one piece, if practicable.

2.13 ENCLOSURES

NEMA ICS 6, NEMA 250 or UL 698 for use in hazardous (classified) locations, unless otherwise specified.

2.13.1 Cabinets and Boxes

Cabinets and boxes with volume greater than 100 cubic inches shall be in accordance with UL 50, hot-dip, zinc-coated, if sheet steel.

2.13.2 Circuit Breaker Enclosures

UL 489.

### 2.13.3 NOT USED

## 2.14 FIXTURES, LIGHTING AND FIXTURE ACCESSORIES/COMPONENTS

Standard Drawing 40-06-04 sheets referenced hereinafter and enclosed as an integral part of these specifications, additional fixtures shown on contract drawings, if any, and UL 844 for fixtures to be installed in hazardous (classified) locations. Fixtures, accessories and components, including ballasts, lampholders, lamps, starters and starter holders, shall conform to industry standards specified below.

### 2.14.1 Fixture, Auxiliary or Emergency

UL 924.

### 2.14.2 Incandescent Fixture

NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1571.

### 2.14.3 Fluorescent

a. Fixture: NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1570. Fixtures shall be plainly marked for proper lamp and ballast type to identify lamp diameter, wattage, color and start type. Marking shall be readily visible to service personnel, but not visible from normal viewing angles.

#### b. Ballasts:

(1) Electronic Ballast. Electronic ballasts shall consist of a rectifier, high frequency inverter, and power control and regulation circuitry. The ballasts shall be UL listed, Class P, with a Class A sound rating and shall contain no PCBs. Ballasts shall meet 47 CFR 18 for electromagnetic interference and shall not interfere with the operation of other electrical equipment. Design shall withstand line transients per IEEE C62.41, Category A. Unless otherwise indicated, the minimum number of ballasts shall be used to serve each individual fixture, using one, two, three or four lamp ballasts. A single ballast may be used to serve multiple fixtures if they are continuous mounted, factory manufactured for that installation with an integral wireway, and are identically controlled.

(a) Light output regulation shall be +/- 10%.

(b) Voltage input regulation shall be +/- 10%.

(c) Lamp current crest factor shall be no more than 1.6.

(d) Ballast factor shall be not less than 85% nor more than 100%, unless otherwise indicated.

(e) A 60 Hz filter shall be provided. Flicker shall be no more than 10% with any lamp suitable for the ballast.

(f) Ballast case temperature shall not exceed 25 degree Celsius rise above 40 degree Celsius ambient, when tested in accordance with UL 935.

(g) Total harmonic distortion shall be in the range of 10-20%.

(h) Power factor shall not be less than 0.95.

(i) Ballasts shall operate at a frequency of 20 kHz or more.

(j) Operating filament voltage shall be 2.5 to 4.5 volts.

(k) Warranty. Three year full warranty including a \$10 labor allowance.

(l) Ballast Efficacy Factor (BEF) shall be in accordance with the following table. Ballasts and lamps shall be matching rapid start or instant start as indicated on the following table. If 32W-F32-T8 lamps and ballasts are used, they must be either all rapid start or all instant start.

ELECTRONIC FLUORESCENT BALLAST EFFICACY FACTORS\*

LAMP TYPE	TYPE OF STARTER & LAMP	NOMINAL OPERATIONAL INPUT VOLTAGE	NUMBER OF LAMPS	MIN. BALLAST EFFICACY FACTOR
32W F32 T8	rapid or instant start	120 or 277 V	1	2.4
			2	1.4
			3	1.0
			4	0.8

\*For ballasts not specifically designed for use with dimming controls

The BEF is calculated using the formula:

BEF = Ballast Factor (in percent) / Power Input

Where Power Input = Total Wattage of Combined Lamps and Ballasts.

c. Lampholders, Starters, and Starter Holders: UL 542.

2.14.4 High-Intensity-Discharge

a. Fixture: NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1572.

b. Ballasts: ANSI C82.4 for multiple supply types and UL 1029.

2.15 LOW-VOLTAGE FUSES AND FUSEHOLDERS

2.15.1 Fuses, Low Voltage Cartridge Type

NEMA FU 1.

2.15.2 Fuses, High-Interrupting-Capacity, Current-Limiting Type

Fuses, Class G, J, L and CC shall be in accordance with UL 198C.

2.15.3 Fuses, Class K, High-Interrupting-Capacity Type

UL 198D.

2.15.4 NOT USED

2.15.5 Fuses, Class R

UL 198E.

2.15.6 NOT USED

UL 198H.

## 2.15.7 Fuses for Supplementary Overcurrent Protection

UL 198G.

## 2.15.8 NOT USED

## 2.15.9 Fuseholders

UL 512.

## 2.16 INSTRUMENTS, ELECTRICAL INDICATING

ANSI C39.1.

## 2.17 MOTORS, AC, FRACTIONAL AND INTEGRAL

Motors, ac, fractional and integral horsepower, 500 hp and smaller shall conform to NEMA MG 1 and UL 1004 for motors; NEMA MG 10 for energy management selection of polyphase motors; and UL 674 for use of motors in hazardous (classified) locations.

### 2.17.1 Rating

The horsepower rating of motors should be limited to no more than 125 percent of the maximum load being served unless a NEMA standard size does not fall within this range. In this case, the next larger NEMA standard motor size should be used.

### 2.17.2 Motor Efficiencies

All permanently wired polyphase motors of 1 hp or more shall meet the minimum full-load efficiencies as indicated in the following table, and as specified in this specification. Motors of 1 hp or more with open, drip proof or totally enclosed fan cooled enclosures shall be high efficiency type, unless otherwise indicated. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section.

#### Minimum Motor Efficiencies

HP	High Efficiency
1	85.5
1.5	85.5
2	85.5
3	88.5
5	88.5
7.5	90.0
10	90.0
15	91.0
20	92.0
25	92.0
30	92.0
HP	High Efficiency
40	92.0
50	92.5
60	92.5
75	95.5
100	93.5
125	94.5

150	94.5
200	94.5
250	94.5
300	94.5
350	94.5
400	94.5
500	94.5

## 2.18 MOTOR CONTROLS AND MOTOR CONTROL CENTERS

### 2.18.1 General

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845. Panelboards supplying non-linear loads shall have neutrals sized for 200 percent of rated current.

### 2.18.2 Motor Starters

Combination starters shall be provided with MCP circuit breakers, IEC contactors and solid state overload relays.

#### 2.18.2.1 NOT USED

### 2.18.3 Thermal-Overload Protection

Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating.

### 2.18.4 Low-Voltage Motor Overload Relays

Overload relays shall conform to NEMA ICS 2 and UL 508. Overload protection shall be provided either integral with the motor or motor controller, and shall be rated in accordance with the requirements of NFPA 70. Overload relays shall be solid-state with the following features: full load current adjustment dial, trip indicator and mechanical trip test lever, phase loss/unbalance sensitivity adjustment dial, isolated 1 NO and 1 NC auxiliary contact, manual reset button and class 10/20/30 selection switch.

### 2.18.5 Automatic Control Devices

#### 2.18.5.1 Direct Control

Automatic control devices (such as thermostats, float or pressure switches) which control the starting and stopping of motors directly shall be designed for that purpose and have an adequate horsepower rating.

#### 2.18.5.2 Pilot-Relay Control

Where the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit.

#### 2.18.5.3 Manual/Automatic Selection

a. Where combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch (marked MANUAL-OFF-AUTOMATIC) shall be provided for the manual control.

b. Where combination manual and automatic control is specified and the automatic-control device actuates the pilot control circuit of a magnetic starter, the magnetic starter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC.

c. Connections to the selector switch shall be such that; only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low-or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

#### 2.18.6 Motor Control Centers

Control centers shall conform to the requirements of NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845. Control centers shall be indoor type and shall contain combination starters and other equipment as indicated. Control centers shall be NEMA ICS 2, Class I, Type B. Each control center shall be mounted on floor sills or mounting channels. Each circuit shall have a suitable metal or laminated plastic nameplate with white cut letters. Motor control centers shall be provided with a full-length ground bus bar.

#### 2.19 PANELBOARDS

Dead-front construction, NEMA PB 1 and UL 67.

#### 2.20 RECEPTACLES

2.20.1 NOT USED

2.20.2 NOT USED

2.20.3 Standard Grade

UL 498.

2.20.4 Ground Fault Interrupters

UL 943, Class A or B.

2.20.5 Hazardous (Classified) Locations

UL 1010.

2.20.6 NEMA Standard Receptacle Configurations

NEMA WD 6.

a. Single and Duplex, 15-Ampere and 20-Ampere, 125 Volt  
15-ampere, non-locking: NEMA type 5-15R, locking: NEMA type L5-15R, 20-ampere, non-locking: NEMA type 5-20R, locking: NEMA type L5-20R.

b. 15-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-15R, locking: NEMA type L6-15R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-15R, locking: NEMA type L15-15R.

c. 20-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-20R, locking: NEMA type L6-20R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-20R, locking: NEMA type L15-20R.

d. 30-Ampere, 125/250 Volt

Three-pole, 3-wire, non-locking: NEMA type 10-30R, locking: NEMA type L10-30R. Three-pole, 4-wire grounding, non-locking: NEMA type 14-30R, locking: NEMA type L14-30R.

e. 30-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-30R, locking: NEMA type L6-30R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-30R, locking: NEMA type L15-30R.

f. 50-Ampere, 125/250 Volt

Three-pole, 3-wire: NEMA type 10-50R. Three-pole, 4-wire grounding: NEMA type 14-50R.

g. 50-Ampere, 250 Volt

Two-pole, 3-wire grounding: NEMA type 6-50R. Three-pole, 4-wire grounding: NEMA type 15-50R.

2.21 Service Entrance Equipment

UL 869A.

2.22 SPLICE, CONDUCTOR

UL 486C.

2.23 POWER-SWITCHGEAR ASSEMBLIES INCLUDING SWITCHBOARDS

Assemblies shall be metal-enclosed, freestanding general-purpose in accordance with NEMA PB 2, UL 891, and IEEE C37.20.1 and shall be installed to provide front access. Busses shall be copper. Assembly shall be approximately 90 inches high; arrangement of circuit breakers and other items specified shall be as indicated. The withstand rating and interrupting capacity of the switchboards and circuit breakers shall be based on the maximum fault current available.

2.23.1 Circuit Breakers

Circuit breakers shall be stationary molded-case circuit breakers equipped with solid state trip units where indicated on switchboard schedule.

2.23.2 Auxiliary Equipment

2.23.2.1 Instruments

Instruments for the switchboard shall be a microprocessor-based multifunction meter mounted at eye level. It shall provide at minimum the following functions: Metering values shall be phase selectable and include Amps for each phase and neutral, Volts (L-L, L-N), Watts, Vars, Voltamperes, Power Factor, Watthours, Varhours (Lag & Lead), Voltamperehours, Current Demand, Peak Current, Watt Demand, Var Demand (Lag & Lead), Peak Voltamperes, Voltampere Demand, and Frequency. Electric meter shall have capability of digital readout and capable of receiving a device to allow future remote monitoring.

#### 2.23.2.2 Instrument Transformers

- a. Potential transformers shall be rated as required for instruments.
- b. Current transformers shall be rated as required for instruments.

#### 2.24 SNAP SWITCHES

UL 20.

#### 2.25 TAPES

##### 2.25.1 Plastic Tape

UL 510.

##### 2.25.2 Rubber Tape

UL 510.

#### 2.26 TRANSFORMERS

Single- and three-phase transformers shall have two windings per phase. Full-capacity standard NEMA taps shall be provided in the primary windings of transformers unless otherwise indicated. Three-phase transformers shall be configured with delta-wye or wye-delta windings, except as indicated. "T" connections may be used for transformers rated 15 kVA or below.

##### 2.26.1 Transformers, Dry-Type

Transformers shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation system for transformers rated 10 kVA and less, with temperature rise not exceeding 80 degrees C under full-rated load in maximum ambient temperature of 40 degrees C. Transformer of 80 degrees C temperature rise shall be capable of carrying continuously 130 percent of nameplate kVA without exceeding insulation rating.

- a. 600 Volt or Less Primary:

NEMA ST 20, UL 506, general purpose, dry-type, self-cooled, ventilated. Provide transformers in NEMA 1 enclosure.

##### 2.26.2 NOT USED

##### 2.26.3 Average Sound Level

The average sound level in decibels (dB) of transformers shall not exceed the following dB level at 12 inches for the applicable kVA rating range listed unless otherwise indicated:

kVA Range	dB Sound Level
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1-50	50
51-150	55
151-300	58
301-500	60
501-700	62
701-1000	64
1001-1500	65
1501 & above	70

2.27 NOT USED

2.28 NOT USED

2.29 NOT USED

## 2.30 INSTRUMENT TRANSFORMERS

### 2.30.1 General

Instrument transformers shall comply with ANSI C12.11 and IEEE ANSI/IEEE C57.13. Instrument transformers shall be configured for mounting in/on the device to which they are applied. Polarity marks on instrument transformers shall be visually evident and shown on drawings.

### 2.30.2 Current Transformers

Unless otherwise indicated, bar, wound, or window-type transformers are acceptable; and except for window-type units installed over insulated buses, transformers shall have a BIL rating consistent with the rated BIL of the associated switchgear or electric power apparatus bushings, buses or conductors. Current transformers shall have the indicated ratios. The continuous thermal-current rating factor shall be not less than 1.0. Other thermal and mechanical ratings of current transformer and their primary leads shall be coordinated with the design of the circuit breaker and shall be not less than the momentary rating of the associated circuit breaker. Circuit protectors shall be provided across secondary leads of the current transformers to prevent the accidental open-circuiting of the transformers while energized. Each terminal of each current transformer shall be connected to a short-circuiting terminal block in the circuit interrupting mechanism cabinet, power transformer terminal cabinet, and in the associated instrument and relay cabinets.

2.30.2.1 NOT USED

2.30.2.2 NOT USED

2.30.2.3 NOT USED

2.30.2.4 NOT USED

### 2.30.2.5 Voltage Transformers

Voltage transformers shall have indicated ratios. Units shall have an accuracy class rating of 0.3. Voltage transformers shall be of the drawout type having current-limiting fuses in both primary and secondary circuits. Mechanical interlocks shall prevent removal of fuses, unless the associated voltage transformer is in a drawout position. Voltage transformer compartments shall have hinged doors.

## 2.31 WIRING DEVICES

NEMA WD 1 for wiring devices, and NEMA WD 6 for dimensional requirements of wiring devices.

#### 2.32 NOT USED

#### 2.33 COORDINATED POWER SYSTEM PROTECTION

Analyses shall be prepared to demonstrate that the equipment and system constructed meet the specified requirements for equipment ratings, coordination, and protection. They shall include a load flow analysis, a fault current analysis, and protective device coordination study. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last three years. The Contractor shall provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

##### 2.33.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin at: the source bus and extend down to system buses where fault availability is 10,000 amperes (symmetrical) for building/facility 600 volt level distribution buses.

##### 2.33.2 Determination of Facts

The Contractor shall coordinate with the base power company for fault current availability at the site. The Contractor shall utilize the fault current availability indicated as a basis for fault current studies.

##### 2.33.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current. A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance diagram is provide, impedance data shall be shown. Locations of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

##### 2.33.4 Fault Current Analysis

###### 2.33.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE Std 242, and IEEE Std 399.

###### 2.33.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedances shall be those proposed. Data shall be documented in the report.

###### 2.33.4.3 Fault Current Availability

Balanced three-phase fault, bolted line-to-line fault, and line-to-ground fault current values shall be provided at each voltage transformation point and at each power distribution bus. The maximum and minimum values of fault available at each location shall be shown in tabular form on the diagram or in the report.

### 2.33.5 Coordination Study

The study shall demonstrate that the maximum possible degree of selectivity has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. The study shall include a description of the coordination of the protective devices in this project. Provide a written narrative that describes: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situation where system coordination is not achievable due to device limitations (an analysis of any device curves which order overlap); coordination between upstream and downstream devices; and relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost changes (addition or reduction) shall be provided. Composite coordination plots shall be provided on log-log graph paper.

### 2.33.6 Study Report

a. The report shall include a narrative: the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.

b. The study shall include descriptive and technical data for existing devices and new protective devices proposed. The data shall include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices.

c. The report shall document utility company data including system voltages, fault MVA, system X/R ratio, time-current characteristic curves, current transformer ratios, and relay device curves and protective device ratings and settings.

d. The report shall contain fully coordinated composite time-current characteristic curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. The report shall include recommended ratings and settings of all protective devices in tabulated form.

e. The report shall provide the calculations performed for the analyses, including computer analysis programs utilized. The name of the software package, developer, and version number shall be provided.

## PART 3 EXECUTION

### 3.1 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following specifications.

#### 3.1.1 Ground Rods

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, additional rods not less than 6 feet on centers can be added. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

### 3.1.2 Ground Bus

Ground bus shall be provided at the main switchboard as indicated. Noncurrent-carrying metal parts of transformer neutrals and other electrical equipment shall be effectively grounded by bonding to the ground bus. The ground bus shall be bonded to both the entrance ground, and to a ground rod and to the grounding counterpoise loops. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment.

### 3.1.3 Grounding Conductors

A green equipment grounding conductor, sized in accordance with NFPA 70 shall be provided, regardless of the type of conduit. Equipment grounding bars shall be provided in all panelboards. The equipment grounding conductor shall be carried back to the service entrance grounding connection or separately derived grounding connection. All equipment grounding conductors, including metallic raceway systems used as such, shall be bonded or joined together in each wiring box or equipment enclosure. Metallic raceways and grounding conductors shall be checked to assure that they are wired or bonded into a common junction. Metallic boxes and enclosures, if used, shall also be bonded to these grounding conductors by an approved means per NFPA 70. When boxes for receptacles, switches, or other utilization devices are installed, any designated grounding terminal on these devices shall also be bonded to the equipment grounding conductor junction with a short jumper.

## 3.2 WIRING METHODS

Wiring shall conform to NFPA 70, the contract drawings, and the following specifications. Unless otherwise indicated, wiring shall consist of insulated conductors installed in rigid zinc-coated steel conduit, electrical metallic tubing, or intermediate metal conduit. Wire fill in conduits shall be based on NFPA 70 for the type of conduit and wire insulations specified. Wire fill in conduits located in Class I or II hazardous areas shall be limited to 25 percent of the cross sectional area of the conduit.

### 3.2.1 Conduit and Tubing Systems

Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on use of copper conductors with insulation types as described in paragraph WIRING METHODS. Minimum size of raceways shall be 1/2 inch. Only metal conduits will be permitted when conduits are required for shielding or other special purposes indicated, or when required by conformance to NFPA 70. Electrical metallic tubing (EMT) may be installed only within buildings. EMT may be installed in concrete and grout in dry locations. EMT installed in concrete or grout shall be provided with concrete tight fittings. EMT shall not be installed in damp or wet locations, or the air space of exterior masonry cavity walls. Bushings, manufactured fittings or boxes providing equivalent means of protection shall be installed on the ends of all conduits and shall be of the insulating type, where required by NFPA 70. Only UL listed adapters shall be used to connect EMT to rigid metal conduit, cast boxes, and conduit bodies. Penetrations of above grade floor slabs, time-rated partitions and fire walls shall be firestopped in accordance with Section C-07270 FIRESTOPPING. Except as otherwise specified, IMC may be used as an option for rigid steel conduit in areas as permitted by NFPA 70. Raceways shall not be installed under the firepits of boilers and furnaces and shall be kept 6 inches away from parallel runs of flues, steam pipes and hot-water pipes. Raceways shall be concealed within finished walls, ceilings, and floors unless otherwise shown. Raceways crossing structural expansion joints or seismic joints shall be provided with suitable expansion fittings or other suitable means to compensate for the building expansion and contraction and to provide for continuity of grounding.

Wiring installed in underfloor raceway system shall be suitable for installation in wet locations.

#### 3.2.1.1 Pull Wires

A pull wire shall be inserted in each empty raceway in which wiring is to be installed if the raceway is more than 50 feet in length and contains more than the equivalent of two 90-degree bends, or where the raceway is more than 150 feet in length. The pull wire shall be of No. 14 AWG zinc-coated steel, or of plastic having not less than 200 pounds per square inch tensile strength. Not less than 10 inches of slack shall be left at each end of the pull wire.

#### 3.2.1.2 Conduit Stub-Ups

Where conduits are to be stubbed up through concrete floors, a short elbow shall be installed below grade to transition from the horizontal run of conduit to a vertical run. A conduit coupling fitting, threaded on the inside shall be installed, to allow terminating the conduit flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 6 inches above the floor. Empty or spare conduit stub-ups shall be plugged flush with the finished floor with a threaded, recessed plug.

#### 3.2.1.3 Below Slab-on-Grade or in the Ground

Electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit passing vertically through slabs-on-grade shall be rigid steel or IMC. Rigid steel or IMC conduits installed below slab-on-grade or in the earth shall be field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system.

#### 3.2.1.4 Installing in Slabs Including Slabs on Grade

Conduit installed in slabs-on-grade shall be rigid steel or IMC. Conduits shall be installed as close to the middle of concrete slabs as practicable without disturbing the reinforcement. Outside diameter shall not exceed 1/3 of the slab thickness and conduits shall be spaced not closer than 3 diameters on centers except at cabinet locations where the slab thickness shall be increased as approved by the Contracting Officer. Where conduit is run parallel to reinforcing steel, the conduit shall be spaced a minimum of one conduit diameter away but not less than one inch from the reinforcing steel.

#### 3.2.1.5 Changes in Direction of Runs

Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Care shall be taken to prevent the lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment during the course of construction. Clogged raceways shall be cleared of obstructions or shall be replaced.

#### 3.2.1.6 Supports

Except where otherwise permitted by NFPA 70, conduits and tubing shall be securely and rigidly fastened in place at intervals of not more than 10 feet and within 3 feet of boxes, cabinets, and fittings, with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps, beam clamps, or ceiling trapeze. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structure. Loads shall not be

applied to joist bridging. Attachment shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or pipe straps shall not be welded to steel structures. Cutting the main reinforcing bars in reinforced concrete beams or joists shall be avoided when drilling holes for support anchors. Holes drilled for support anchors, but not used, shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Raceways shall not be supported using wire or nylon ties. Raceways shall be independently supported from the structure. Upper raceways shall not be used as a means of support for lower raceways. Supporting means will not be shared between electrical raceways and mechanical piping or ducts. Cables and raceways shall not be supported by ceiling grids. Except where permitted by NFPA 70, wiring shall not be supported by ceiling support systems. Conduits shall be fastened to sheet-metal boxes and cabinets with two locknuts where required by NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered. Additional support for horizontal runs is not required when EMT rests on steel stud cutouts.

#### 3.2.1.7 Exposed Raceways

Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above accessible ceilings shall be considered as exposed installations in accordance with NFPA 70 definitions.

#### 3.2.1.8 NOT USED

#### 3.2.1.9 NOT USED

#### 3.2.1.10 Communications Raceways

Communications raceways indicated shall be installed in accordance with the previous requirements for conduit and tubing and with the additional requirements that no length of run shall exceed 50 feet for 1/2 inch and 3/4 inch sizes, and 100 feet for 1 inch or larger sizes, and shall not contain more than two 90-degrees bends or the equivalent. Additional pull or junction boxes shall be installed to comply with these limitations whether or not indicated. Inside radii of bends in conduits of 1 inch size or larger shall not be less than ten times the nominal diameter.

#### 3.2.2 NOT USED

#### 3.2.3 NOT USED

#### 3.2.4 Cables and Conductors

Installation shall conform to the requirements of NFPA 70. Covered, bare or insulated conductors of circuits rated over 600 volts shall not occupy the same equipment wiring enclosure, cable, or raceway with conductors of circuits rated 600 volts or less.

##### 3.2.4.1 Sizing

Unless otherwise noted, all sizes are based on copper conductors and the insulation types indicated. Sizes shall be not less than indicated. Branch-circuit conductors shall be not smaller than No. 12 AWG. Conductors for branch

circuits of 120 volts more than 100 feet long and of 277 volts more than 230 feet long, from panel to load center, shall be no smaller than No. 10 AWG. Class 1 remote control and signal circuit conductors shall be not less than No. 14 AWG. Class 2 remote control and signal circuit conductors shall be not less than No. 16 AWG.

#### 3.2.4.2 Use of Aluminum Conductors in Lieu of Copper

Aluminum conductors shall not be used.

#### 3.2.4.3 Cable Systems

Cable systems shall be installed where indicated. Cables shall be installed concealed behind ceiling or wall finish where practicable. Cables shall be threaded through holes bored on the approximate centerline of wood members; notching of surfaces will not be permitted. Sleeves shall be provided through bond beams of masonry-block walls for threading cables through hollow spaces. Exposed cables shall be installed parallel or at right angles to walls or structural members. In rooms or areas not provided with ceiling or wall finish, cables and outlets shall be installed so that a room finish may be applied in the future without disturbing the cables or resetting the boxes.

#### 3.2.4.4 NOT USED

#### 3.2.4.5 Cable Splicing

Splices shall be made in an accessible location. Crimping tools and dies shall be approved by the connector manufacturer for use with the type of connector and conductor.

a. Copper Conductors, 600 Volt and Under: Splices in conductors No. 10 AWG and smaller diameter shall be made with an insulated, pressure-type connector. Splices in conductors No. 8 AWG and larger diameter shall be made with a solderless connector and insulated with tape or heat-shrink type insulating material equivalent to the conductor insulation.

#### 3.2.4.6 Conductor Identification and Tagging

Power, control, and signal circuit conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation. Phase conductors of low voltage power circuits shall be identified by color coding. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

a. Color coding shall be provided for service, feeder, branch, and ground conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in the same raceway or box, other neutral shall be white with colored (not green) stripe. The color coding for three-phase and single-phase low voltage systems shall be as follows:

120/208-volt, 3-phase: Black(A), red(B), and blue(C).

b. Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored electrical tape wrapped around the insulation for a minimum of

3 inches of length near the end, or other method as submitted by the Contractor and approved by the Contracting Officer.

c. Control and signal circuit conductor identification shall be made by color-coded insulated conductors, plastic-coated self-sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved detail drawings. Hand lettering or marking is not acceptable.

### 3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems where required by NFPA 70 for pulling of wires, making connections, and mounting of devices or fixtures. Pull boxes shall be furnished with screw-fastened covers. Indicated elevations are approximate, except where minimum mounting heights for hazardous areas are required by NFPA 70. Unless otherwise indicated, boxes for wall switches shall be mounted 48 inches above finished floors. Switch and outlet boxes located on opposite sides of fire rated walls shall be separated by a minimum horizontal distance of 24 inches. The total combined area of all box openings in fire rated walls shall not exceed 100 square inches per 100 square feet. Maximum box areas for individual boxes in fire rated walls vary with the manufacturer and must not exceed the maximum specified for that box in UL-03. Only boxes listed in UL-03 shall be used in fire rated walls.

#### 3.3.1 Box Applications

Each box shall have not less than the volume required by NFPA 70 for number of conductors enclosed in box. Boxes for metallic raceways, 4 by 4 inch nominal size and smaller, shall be of the cast-metal hub type when located in normally wet locations, when flush and surface mounted on outside of exterior surfaces, or when located in hazardous areas. Cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Boxes for mounting lighting fixtures shall be not less than 4 inches square, or octagonal, except smaller boxes may be installed as required by fixture configuration, as approved. Cast-metal boxes with 3/32 inch wall thickness are acceptable. Large size boxes shall be NEMA 12 or as shown. Boxes in other locations shall be sheet steel except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic conduit and tubing or nonmetallic sheathed cable system, when permitted by NFPA 70. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers.

#### 3.3.2 Brackets and Fasteners

Boxes and supports shall be fastened to wood with wood screws or screw-type nails of equal holding strength, with bolts and metal expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screw or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts, or nail-type nylon anchors may be used in lieu of expansion shields, or machine screws. Penetration of more than 1-1/2 inches into reinforced-concrete beams or more than 3/4 inch into reinforced-concrete joists shall avoid cutting any main reinforcing steel. The use of brackets which depend on gypsum wallboard or plasterboard for primary support will not be permitted. In partitions of light steel construction, bar hangers with 1 inch long studs, mounted between metal wall studs or metal box mounting brackets shall be used to secure boxes to the building structure. When metal box mounting brackets are used, additional box support shall be provided on the side of the box opposite the brackets. This additional box support shall consist of a minimum 12 inch long section of wall stud, bracketed to the opposite side of



the box and secured by two screws through the wallboard on each side of the stud. Metal screws may be used in lieu of the metal box mounting brackets.

### 3.3.3 Mounting in Walls, Ceilings, or Recessed Locations

In walls or ceilings of concrete, tile, or other non-combustible material, boxes shall be installed so that the edge of the box is not recessed more than 1/4 inch from the finished surface. Boxes mounted in combustible walls or ceiling material shall be mounted flush with the finished surface. The use of gypsum or plasterboard as a means of supporting boxes will not be permitted. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers, as required. The bottom of boxes installed in masonry-block walls for concealed wiring shall be mounted flush with the top of a block to minimize cutting of the blocks, and boxes shall be located horizontally to avoid cutting webs of block. Separate boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided.

### 3.3.4 Installation in Overhead Spaces

In open overhead spaces, cast-metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast-metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Hangers shall not be fastened to or supported from joist bridging. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 24 inches from the box.

## 3.4 DEVICE PLATES

One-piece type device plates shall be provided for all outlets and fittings. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel, cast-metal, or impact resistant plastic having rounded or beveled edges. Plates on finished walls shall be of steel with baked enamel finish or impact-resistant plastic and shall be ivory. Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed and provided with a hinged, gasketed cover, unless otherwise specified.

## 3.5 RECEPTACLES

### 3.5.1 Single and Duplex, 15 or 20-ampere, 125 volt

Single and duplex receptacles shall be rated 20 amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots. Bodies shall be of ivory to match color of switch handles in the same room or to harmonize with the color of the respective wall, and supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side- or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke. Switched receptacles shall be the same as other receptacles specified except that the ungrounded pole of each suitable receptacle shall be provided with a separate terminal. Only the top receptacle of a duplex receptacle shall be wired for switching application. Receptacles with ground fault circuit interrupters shall have the current rating as indicated, and shall be UL Class A type unless otherwise shown. Ground fault circuit protection shall be provided as required by NFPA 70 and as indicated on the drawings.

3.5.2 NOT USED

3.5.3 NOT USED

#### 3.5.4 Weatherproof Applications

Weatherproof receptacles shall be suitable for the environment, damp or wet as applicable, and the housings shall be labeled to identify the allowable use. Receptacles shall be marked in accordance with UL 514A for the type of use indicated; "Damp locations", "Wet Locations", "Wet Location Only When Cover Closed". Assemblies shall be installed in accordance with the manufacturer's recommendations.

##### 3.5.4.1 Damp Locations

Receptacles in damp locations shall be mounted in an outlet box with a gasketed, weatherproof, cast-metal cover plate (device plate, box cover) and a gasketed cap (hood, receptacle cover) over each receptacle opening. The cap shall be either a screw-on type permanently attached to the cover plate by a short length of bead chain or shall be a flap type attached to the cover with a spring loaded hinge.

##### 3.5.4.2 Wet Locations

Receptacles in wet locations shall be installed in an assembly rated for such use whether the plug is inserted or withdrawn, unless otherwise indicated. In a duplex installation, the receptacle cover shall be configured to shield the connections whether one or both receptacles are in use.

3.5.5 NOT USED

3.5.6 NOT USED

3.5.7 NOT USED

3.5.8 NOT USED

3.5.9 NOT USED

3.5.10 NOT USED

##### 3.5.11 Special-Purpose or Heavy-Duty Receptacles

Special-purpose or heavy-duty receptacles shall be of the type and of ratings and number of poles indicated or required for the anticipated purpose. Contact surfaces may be either round or rectangular. One appropriate straight or angle-type plug shall be furnished with each receptacle. Locking type receptacles, rated 30 amperes or less, shall be locked by rotating the plug. Locking type receptacles, rated more than 50 amperes, shall utilize a locking ring.

#### 3.6 WALL SWITCHES

Wall switches shall be of the totally enclosed tumbler type. The wall switch handle and switch plate color shall be ivory as indicated. Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement. Not more than one switch shall be installed in a single-gang position. Switches shall be rated 20-ampere 120 volt for use on alternating current only. Pilot lights indicated shall consist of yoke-mounted candelabra-base sockets rated at 75 watts, 125 volts, and fitted with glass or plastic jewels. A clear 6-watt lamp shall be furnished and installed in each pilot switch. Jewels for use with switches controlling motors shall be green,

and jewels for other purposes shall be red. Dimming switches shall be solid-state flush mounted, sized for the loads.

### 3.7 SERVICE EQUIPMENT

Service-disconnecting means shall be of the enclosed molded-case circuit breaker type with an external handle for manual operation. When service disconnecting means is a part of an assembly, the assembly shall be listed as suitable for service entrance equipment. Enclosures shall be sheet metal with hinged cover for surface mounting unless otherwise indicated.

### 3.8 PANELBOARDS AND LOADCENTERS

Circuit breakers and switches used as a motor disconnecting means shall be capable of being locked in the open position. Door locks shall be keyed alike. Nameplates shall be as approved. Directories shall be typed to indicate loads served by each circuit and mounted in a holder behind a clear protective covering. Busses shall be copper.

#### 3.8.1 Loadcenters

Loadcenters shall be circuit breaker equipped.

#### 3.8.2 Panelboards

Panelboards shall be circuit breaker or fusible switch equipped as indicated on the drawings.

### 3.9 FUSES

Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilize fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and shall have the time-current characteristics required for effective power system coordination.

#### 3.9.1 NOT USED

#### 3.9.2 Cartridge Fuses; Current-Limiting Type

Cartridge fuses, current-limiting type, Class RK5 shall have tested interrupting capacity not less than 200,000 amperes. Fuse holders shall be the type that will reject all Class H fuses.

#### 3.9.3 NOT USED

#### 3.9.4 NOT USED

#### 3.9.5 Motor and Transformer Circuit Fuses

Motor, motor controller, transformer, and inductive circuit fuses shall be Class RK1 or RK5, current-limiting, time-delay with 100,000 amperes interrupting capacity.

### 3.10 UNDERGROUND SERVICE

Unless otherwise indicated, interior conduit systems shall be stubbed out 5 feet beyond the building wall and 2 feet below finished grade, for interface with the

exterior service lateral conduits ~~and exterior communications conduits~~. Outside conduit ends shall be bushed when used for direct burial service lateral conductors. Outside conduit ends shall be capped or plugged until connected to exterior conduit systems. Underground service lateral conductors will be extended to building service entrance and terminated in accordance with the requirements of Section C-16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and NFPA 70.

### 3.11 NOT USED

### 3.12 MOTORS

Each motor shall conform to the hp and voltage ratings indicated, and shall have a service factor and other characteristics that are essential to the proper application and performance of the motors under conditions shown or specified. Three-phase motors for use on 3-phase 208-volt systems shall have a nameplate rating of 200 volts. Unless otherwise specified, all motors shall have open frames, and continuous-duty classification based on a 40 degree C ambient temperature reference. Polyphase motors shall be squirrel-cage type, having normal-starting-torque and low-starting-current characteristics, unless other characteristics are specified in other sections of these specifications or shown on contract drawings. The Contractor shall be responsible for selecting the actual horsepower ratings and other motor requirements necessary for the applications indicated. When electrically driven equipment furnished under other sections of these specifications materially differs from the design, the Contractor shall make the necessary adjustments to the wiring, disconnect devices and branch-circuit protection to accommodate the equipment actually installed.

### 3.13 MOTOR CONTROL

Each motor or group of motors requiring a single control shall be provided under other sections of these specifications with a suitable controller and devices that will perform the functions as specified for the respective motors. Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating. Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for that purpose and have an adequate horsepower rating. When the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit. When combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch shall be provided for the manual control; when the automatic-control device actuates the pilot control circuit of a magnetic starter, the latter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low- or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

#### 3.13.1 NOT USED

#### 3.13.2 Motor Control Centers

Control centers shall be indoor type and shall contain combination starters and other equipment as indicated. Control centers shall be NEMA ICS 2, Class I, Type B. Each control center shall be mounted on floor sills or mounting channels. Each circuit shall have a suitable metal or laminated plastic nameplate with white cut letters. Combination starters shall be provided with MCP circuit breakers. Motor control centers shall be provided with a full-length ground bus bar.

#### 3.13.3 Contacts

Unless otherwise indicated, contacts in miscellaneous control devices such as float switches, pressure switches, and auxiliary relays shall have current and voltage ratings in accordance with NEMA ICS 2 for rating designation B300.

#### 3.13.4 Safety Controls

Safety controls for boilers shall be connected to a 2-wire, 120 volt grounded circuit supplied from the associated boiler-equipment circuit. Where the boiler circuit is more than 120 volts to ground, safety controls shall be energized through a two-winding transformer having its 120 volt secondary winding grounded. Overcurrent protection shall be provided in the ungrounded secondary conductor and shall be sized for the load encountered.

#### 3.14 MOTOR-DISCONNECT MEANS

Each motor shall be provided with a disconnecting means when required by NFPA 70 even though not indicated. For single-phase motors, a single or double pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor rating. Switches shall disconnect all ungrounded conductors.

#### 3.15 TRANSFORMER INSTALLATION

Three-phase transformers shall be connected only in a delta-wye or wye-delta configuration as indicated. "T" connections may be used for transformers rated at 15 kVA or below. Dry-type transformers shown located within 5 feet of the exterior wall shall be provided in a weatherproof enclosure. Transformers to be located within the building may be provided in the manufacturer's standard, ventilated indoor enclosure designed for use in 40 degrees C ambient temperature, unless otherwise indicated.

#### 3.16 LAMPS AND LIGHTING FIXTURES

Ballasted fixtures shall have ballasts which are compatible with the specific type and rating of lamps indicated and shall comply with the applicable provisions of the publications referenced.

##### 3.16.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed in the fixtures just prior to the completion of the project.

##### 3.16.1.1 Incandescent

Incandescent lamps shall be for 125-volt operation unless otherwise indicated.

### 3.16.1.2 Fluorescent

Fluorescent lamps for magnetic ballasts shall have standard cool-white color characteristics and shall be of a type that will not require starter switches. Lamps shall be of the rapid-start type unless otherwise shown or approved.

### 3.16.1.3 High-Intensity-Discharge

High-intensity-discharge lamps shall be the high-pressure sodium type unless otherwise indicated, shown, or approved.

## 3.16.2 Fixtures

Fixtures shall be as shown and shall conform to the following specifications and shall be as detailed on Standard Drawing No. 40-06-04, Sheet Nos. 15, 16, 17, 20, 28, 31, 33, 36, 38, 43, 44, 56, 60, 64, and 66 which accompany and form a part of this specification for the types indicated. Illustrations shown on these sheets are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar designs and equivalent energy efficiency, light distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved. In suspended acoustical ceilings with fluorescent fixtures, the fluorescent emergency light fixtures shall be furnished with self-contained battery packs.

### 3.16.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation. Open type fluorescent fixtures with exposed lamps shall have a wire-basket type guard.

### 3.16.2.2 Suspended Fixtures

Suspended fixtures shall be provided with swivel hangers in order to ensure a plumb installation. Pendants, rods, or chains 4 feet or longer excluding fixture, shall be braced to limit swinging. Bracing shall be 3 directional, 120 degrees apart. Single unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple unit or continuous-row fluorescent units shall have a tubing or stem for wiring at one point, and a tubing or rod suspension provided for each length of chassis including one at each end. Maximum distance between adjacent tubing or stems shall be 10 feet. Rods shall be of not less than 3/16 inch diameter. Flexible raceway shall be installed to each fixture from an overhead junction box. Fixture to fixture wiring installation is allowed only when fixtures are installed end to end in a continuous run.

### 3.16.2.3 Ceiling Fixtures

Ceiling fixtures shall be coordinated with and suitable for installation in, on, or from the suspended ceiling provided under other sections of these specifications. Installation and support of fixtures shall be in accordance with the NFPA 70 and manufacturer's recommendations. Recessed fixtures shall have adjustable fittings to permit alignment with ceiling panels. Recessed fixtures installed in fire-resistive type of suspended ceiling construction shall have the same fire rating as the ceiling or shall be provided with fireproofing boxes having materials of the same fire rating as the ceiling panels, in conformance with UL-03. Surface-mounted fixtures shall be suitable for fastening to the structural support for ceiling panels.

### 3.16.2.4 Sockets

Sockets of industrial, strip, and other open type fluorescent fixtures shall be of the type requiring a forced movement along the longitudinal axis of the lamp for insertion and removal of the lamp.

### 3.16.3 Emergency Light Sets

Emergency light sets shall conform to UL 924 with the number of heads as indicated. Sets shall be permanently connected to the wiring system by conductors installed in short lengths of flexible conduit.

### 3.17 BATTERY CHARGERS

Battery chargers shall be installed in conformance with NFPA 70.

### 3.18 EQUIPMENT CONNECTIONS

All wiring not furnished and installed under other sections of the specifications for the connection of electrical equipment as indicated on the drawings shall be furnished and installed under this section of the specifications. Connections shall comply with the applicable requirements of paragraph WIRING METHODS. Flexible conduits 6 feet or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. All motors shall be provided with separate grounding conductors. Liquid-tight conduits shall be used in damp or wet locations.

#### 3.18.1 Motors and Motor Control

Motors, motor controls, and motor control centers shall be installed in accordance with NFPA 70, the manufacturer's recommendations, and as indicated. Wiring shall be extended to motors, motor controls, and motor control centers and terminated.

#### 3.18.2 NOT USED

#### 3.18.3 NOT USED

### 3.19 CIRCUIT PROTECTIVE DEVICES

The Contractor shall calibrate, adjust, set and test each new adjustable circuit protective device to ensure that they will function properly prior to the initial energization of the new power system under actual operating conditions.

### 3.20 PAINTING AND FINISHING

Field-applied paint on exposed surfaces shall be provided under Section C-09900 PAINTING, GENERAL.

### 3.21 REPAIR OF EXISTING WORK

The work shall be carefully laid out in advance, and where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceiling, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved at no additional cost to the Government.

### 3.22 FIELD TESTING

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 7 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to

conduct field tests. The Contractor shall perform all tests and inspection recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. All field test reports will be signed and dated by the Contractor.

#### 3.22.1 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

#### 3.22.2 Ground-Resistance Tests

The resistance of the grounding grid shall be measured using the fall-of-potential method defined in IEEE Std 81. Soil resistivity in the area of the grid shall be measured concurrently with the grid measurements. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

- a. Single rod electrode - 25 ohms.
- b. Grid electrode - 25 ohms.

#### 3.22.3 Ground-Grid Connection Inspection

All below-grade ground-grid connections will be visually inspected by the Contracting Officer before backfilling. The Contractor shall notify the Contracting Officer 24 hours before the site is ready for inspection.

#### 3.22.4 Cable Tests

The Contractor shall be responsible for identifying all equipment and devices that could be damaged by application of the test voltage and ensuring that they have been properly disconnected prior to performing insulation resistance testing. An insulation resistance test shall be performed on all low and medium voltage cables after the cables are installed in their final configuration and prior to energization. The test voltage shall be 500 volts DC applied for one minute between each conductor and ground and between all possible combinations of conductors. The minimum value of resistance shall be:

$R \text{ in megohms} = (\text{rated voltage in kV} + 1) \times 1000 / (\text{length of cable in feet})$

Each cable failing this test shall be repaired or replaced. The repaired cable system shall then be retested until failures have been eliminated.

##### 3.22.4.1 NOT USED

##### 3.22.4.2 Low Voltage Cable Tests

- a. Continuity test.
- b. Insulation resistance test.

##### 3.22.5 NOT USED



#### 3.22.6 Motor Tests

- a. Phase rotation test to ensure proper directions.
- b. Operation and sequence of reduced voltage starters.
- c. High potential test on each winding to ground.
- d. Insulation resistance of each winding to ground.
- e. Vibration test.
- f. Dielectric absorption test on motor ~~and starter~~.

#### 3.22.7 NOT USED

#### 3.22.8 NOT USED

#### 3.22.9 NOT USED

#### 3.22.10 Motor Control Centers

- a. Insulation resistance test phase-to-phase, all combinations.
- b. Insulation resistance test phase-to-ground, each phase.
- c. Manual and electrical operational tests.

#### 3.22.11 NOT USED

#### 3.23 OPERATING TESTS

After the installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements. An operating test report shall be submitted in accordance with paragraph FIELD TEST REPORTS.

#### 3.24 FIELD SERVICE

##### 3.24.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 16 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations.

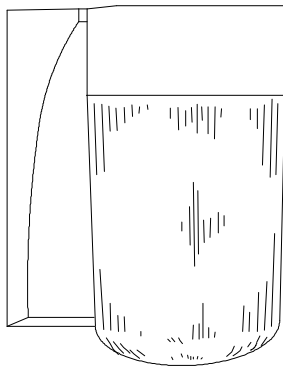
##### 3.24.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of equipment, assist in the performance of the onsite tests, oversee initial operations, and instruct personnel as to the operational and maintenance features of the equipment.

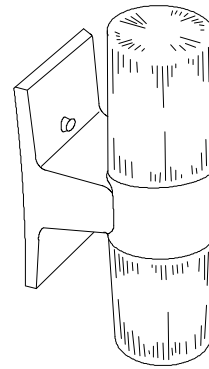
#### 3.25 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

--END OF SECTION--



TYPE 124



TYPE 125

Exterior Wall Mounted Enclosed and Gasketed  
Fixtures For Wet Locations

## Suffix

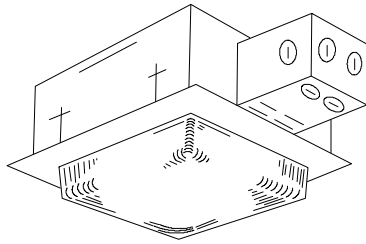
A  
B

## Description

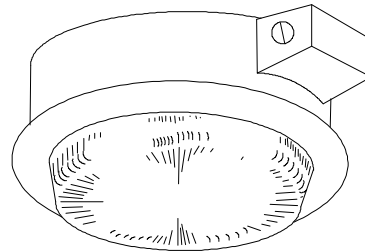
Without protective guard  
With protective guard

Fixture shall conform to UL 1571 or UL 1570. Fixture shall be suitable for use in wet locations and shall be enclosed and gasketed. The round housing and wall bracket shall be cast aluminum provided with a brushed or satin aluminum finish and a clear acrylic lacquer protective coating. The lampholder shall be medium base glazed porcelain. The housing shall be threaded to receive the threaded globe. The globe shall be white opal tempered glass. The protective guard shall be cast aluminum and finished as specified for housing. Fixture shall be prewired. ++

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.



TYPE 126  
Square



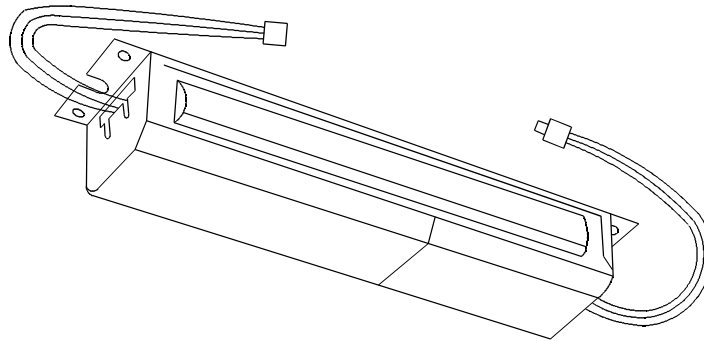
TYPE 127  
Round

Weathertight, Insect-proof, Recessed Fixture

First Suffix	Second Suffix	Description
A		Drop white opal glass lens
B		Flat prismatic glass lens
	1	Suspended plaster installation
	2	Concrete pour installation

Fixture shall conform to UL 1571 or UL 1570 for use in wet locations and shall be enclosed and gasketed. Fixture shall be suitable for installation in outdoor soffits. The housing shall be 18 gage hot-dipped galvanized steel and shall have sealed seam construction. The housing for suspended plaster installation shall be provided with hot-dipped galvanized steel sheet metal splice compartment and plaster frame. The housing for concrete pour installation shall be provided with a cast aluminum splice compartment. The interior surfaces of the housing shall be finished with baked white enamel. The reflector shall be one piece specular aluminum. The lampholder shall be medium base glazed porcelain. The lens frame shall be one piece cast aluminum with a 1/8-inch minimum wall thickness. The lens frame shall have a brushed satin aluminum finish and be provided with a clear acrylic lacquer protective coating. The lens frame shall be held securely to the fixture housing with a hinge and self-centering captive screws or with a chain-hinge and four self-centering captive screws. A round neoprene factory installed gasket shall be provided between the lens frame and the ceiling. A flat gasket shall be provided between the lens frame and the glass diffuser. The glass lens shall have a minimum thickness of 1/4 inch. The lens shall be held securely to the lens frame and gasket with steel clips and screws. Fixture shall be prewired. Fixture shall be rated lamp size and type specified. ++

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.

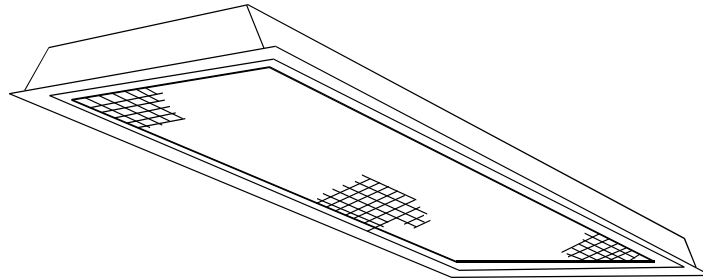


TYPE 200

#### Emergency Battery and Lamp Supply Unit for Fluorescent Fixtures

The unit shall conform to UL 924 and be UL Listed for field or factory installation. The unit shall be dual-rated for use on either 120 or 277 Volt lighting circuits, and shall meet or exceed NFPA 70 time and voltage requirements. The unit shall be capable of automatically supplying a minimum of 15 percent of the rated lumen output of a standard 4-foot, 40 watt rapid start fluorescent lamp in one minute following the failure of the normal power supply. It shall provide a minimum of 60 percent of the initial emergency illumination at the end of the 90-minute discharge period. The battery charger shall be capable of fully recharging the battery within 24 hours after the return of the normal power supply and, under normal operations, shall trickle charge the battery to maintain it in a fully charged condition. The unit shall be capable of operating at least one of the lamps in the fixture which also houses the unit and shall consist of a high temperature, pocket-plate type of nickel cadmium battery, charger, and electronic circuitry in one compact housing. A conveniently located test switch shall be provided to test the solid-state circuitry and the readiness of the battery. The battery shall be designed to require no maintenance during the expected life, be warranted for not less than three years from the date of the purchase of the unit, and be field replaceable without requiring removal of other components of the unit. Other components of the unit shall be fully warranted for not less than 18 months from the date of purchase of the unit. ++

The Emergency Battery and Lamp Supply Unit indicated on this sheet shall be provided as indicated on other sheets, and shall also conform to requirements specified or indicated in the contract documents.



TYPE 206  
Static Troffer

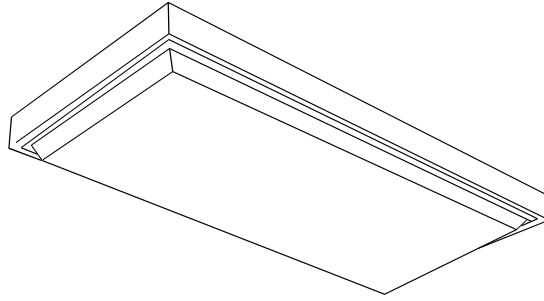
TYPE 207  
Air Handling Troffer

Recessed Fluorescent Fixture, 2-foot by 4-foot

First Suffix	Second Suffix	Third Suffix	Description
A			Two lamps
B			Three lamps
C			Four lamps
	1		Prismatic acrylic lens
	2		1/2- by 1/2- by 1/2-inch acrylic cube louver
	3		1/2- by 1/2- by 1/2-inch polystyrene cube louver
		A	Type 200 emergency unit

Fixture shall conform to UL 1570. Housing shall be complete with integral side trim flanges. Housing and trim flanges shall be cold-rolled steel. The lens or louver shall be installed in a manner that will prevent it from coming loose due to vibration. The ballasts and wiring shall be enclosed in a wireway that is continuous throughout the length of the fixture and which forms a wireway for circuits through the fixture. All metal parts shall receive a rust inhibitive coating before application of the finish coat. The finish coat shall be baked enamel. Lenses and acrylic cube louvers shall be 100 percent virgin acrylic plastic. The lens or louver shall be four feet in length. Acrylic lens shall be flat, 0.125 inch nominal thickness, low brightness, with smooth top surface and a lower surface having a regular array of prismatic elements. Fixture shall be prewired. ++

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.



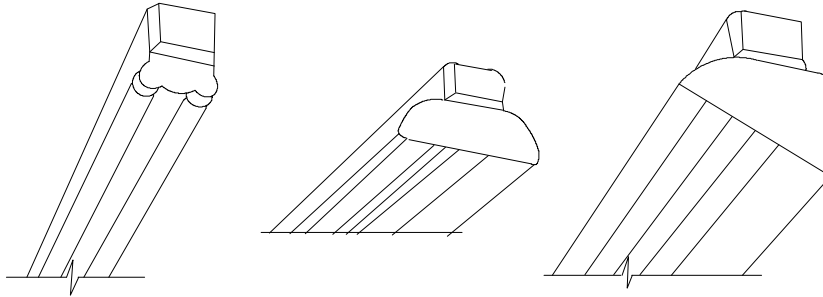
TYPE 216

Surface, Ceiling Mounted Fluorescent Fixture, 2-foot by 4-foot,  
With Drop Opal Lens

First Suffix	Second Suffix	Description
A		Two lamps
B		Three lamps
C		Four lamps
	1	Type 200 emergency unit

Fixture shall conform to UL 1570. Housing shall be cold-rolled steel. The lens shall be installed in a manner that will prevent it from coming loose due to vibration. The ballasts and wiring shall be enclosed in a wireway that is continuous throughout the length of the fixture and which forms a wireway for circuits through the fixture. All metal parts shall receive a rust inhibitive coating before application of the finish coat. The finish coat shall be baked white enamel. Lens shall be 100 percent virgin acrylic plastic. Fixture shall be prewired. ++

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.



TYPE 220  
Without  
Reflector

TYPE 221  
With Symmetric  
Reflector

TYPE 222  
With Asymmetric  
Reflector

Four Foot Single- and Two-Lamp Fluorescent Strip Fixture

Suffix

Description

A

One lamp

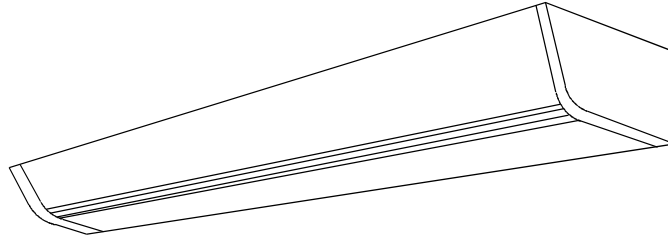
B

Two lamps

Fixture shall be constructed of cold-rolled steel and shall conform to UL 1570. The fixture shall have a die-formed steel channel, suitable mounting holes, and 1/2-inch knockouts in back. Channel and end fittings shall have a baked white enamel finish. The channel and end fittings shall be removed to permit the installation of a continuous row of fixtures, the closure of fixtures at the ends of continuous rows, and the closure of the ends of individually mounted fixtures with no light leakage. Channel covers shall have threaded fittings for reflector mounting, shall be constructed of die-formed steel, and shall be finished with baked white enamel. All ferrous metal parts shall receive a rust inhibitive coating before application of finish coat. Reflectors shall be designed for direct attachment to the channel cover with suitable threaded fittings. Reflectors shall be manufacturer's standard commercial product and shall be constructed of die-formed aluminum with highly polished finish, or steel with white porcelain enamel finish, or steel with baked white enamel finish. Fixture shall be suitable for pendant and surface mounting. Fixture shall be prewired. Fluorescent tubes shall be protected by a virgin acrylic protective sleeve and clear plastic vented end caps. ++

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.





TYPE 224  
One Lamp  
48-inch Length

TYPE 225  
Two Lamps  
48-inch Length

Enclosed, Wall Mounted, Direct Fluorescent Fixture

Fixture shall conform to UL 1570. Housing shall be of cold-rolled, die-formed steel. The back housing shall be one piece, solid along its entire length. End plates shall be die-formed and shall be fastened securely to the housing in a manner that permits no light leakage. All metal parts shall receive a rust inhibitive coating and a baked white enamel finish coat. Lens shall be prismatic, one piece, 0.125 inch nominal thickness, and 100 percent virgin acrylic. The lens shall be easily removed without the use of tools and shall be held in place by concealed hinges, by reinforcing ribs along the edges, or by resting on the end plates. The lens shall be attached to the housing so there is no light leakage. Fixture shall be prewired. ++

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.

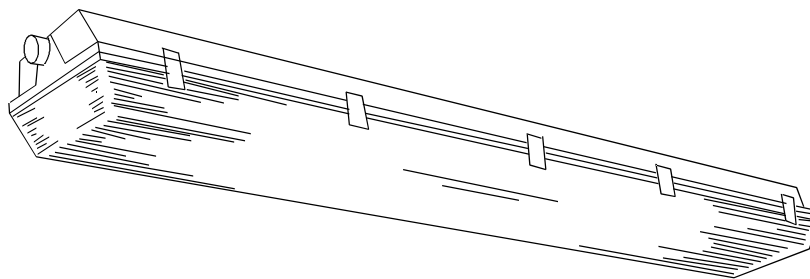


TYPE 230  
Suspension Mounted, Industrial,  
Open Type Fluorescent Fixture, 4-Foot

First-Suffix	Second-Suffix	Description
A		Two lamps
B		Three lamps
	1	18 to 15 percent uplight
	2	18 to 25 percent uplight

Fixture shall conform to UL 1570. Channel housing, end fittings, and reflector shall be constructed with die-formed, cold-rolled steel. Reflector finish shall be porcelain enamel, baked white enamel or aluminum oxide. Fixture shall be prewired. Fluorescent tubes shall be protected by a virgin acrylic protective sleeve and clear plastic vented end caps.

++



TYPE 232  
4-Foot Fixture Length

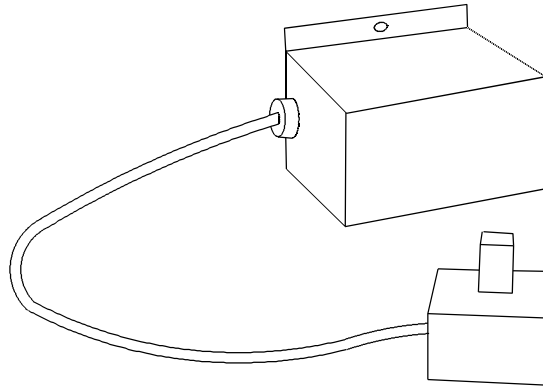
TYPE 233  
8-Foot Fixture Length

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.

Enclosed and Gasketed, Vapor-Tight Fluorescent Fixture  
For Surface or Pendant Mounting

Fixture shall conform to UL 1570 and shall be vapor-tight and suitable for use in wet locations. Fixture shall have one-piece housing of molded high-impact plastic or reinforced fiberglass. Housing body shall have an internal, die-formed, cold-rolled steel channel with cover to provide fixture rigidity and to contain electric components. The metal channel and cover shall receive a rust inhibitive coating before application of the finish coat, which shall consist of baked white enamel or porcelain enamel. The lens shall be one piece, of high-impact-resistant acrylic, and shall have smooth exterior surface and stippled or pebbled interior surface. The lens shall be secured to the housing with captive molded plastic or stainless steel spring latches. A continuous gasket shall be provided to form a vapor seal between the lens and the fixture body. All openings in the housing for mounting, conduit, etc., shall be capable of forming a vapor-tight seal. Ballast(s) shall be cold weather type for starting temperatures down to minus 20 degrees F. Fixture shall be prewired, and provided with lamps that are properly mated to the ballast operating characteristics. ++

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.



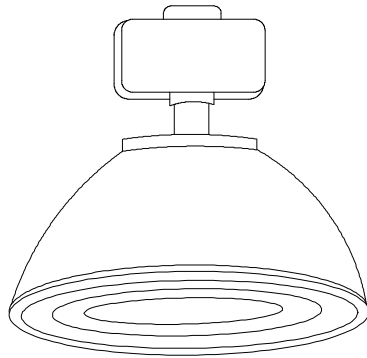
TYPE 300

Emergency 250 Watt Quartz Standby Light System  
For High Intensity Discharge Fixtures

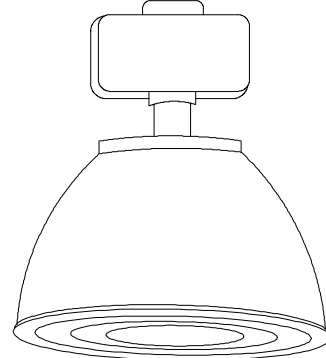
Emergency quartz standby system shall be the delayed type which shall provide standby illumination when the high intensity discharge fixture is energized, following a prolonged period of deenergization. The system shall also automatically cause the energization of the quartz lamp when the input voltage supplied to the fixture drops below the voltage required to maintain the arc in the lamp through the output of the ballast. The system shall deenergize the quartz lamp when the high intensity discharge lamp reaches 40 percent of its rated lumen output. The system shall be provided by the high intensity discharge fixture manufacturer, shall be a separate attachment as illustrated or integrally incorporated into the fixture components, and shall be factory installed and prewired. Maximum power required for the fixture during periods when both lamps are energized shall be indicated on the fixture nameplate. The system shall include step-down transformer if the system operates at a voltage rating different from the voltage rating specified or indicated for the high intensity discharge fixture.

The standby system indicated on this sheet shall be provided as indicated on other sheets and shall also conform to requirements specified and indicated in the contract documents.++

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.



TYPE 301  
High Bay



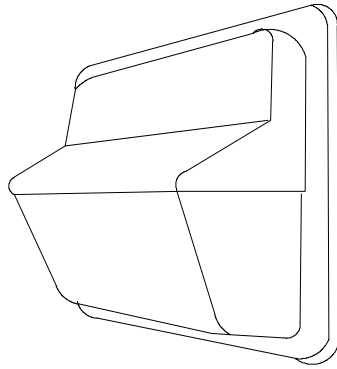
TYPE 302  
Low Bay

Enclosed, Pendant, Integrally Ballasted, Industrial,  
High Intensity Discharge Fixture

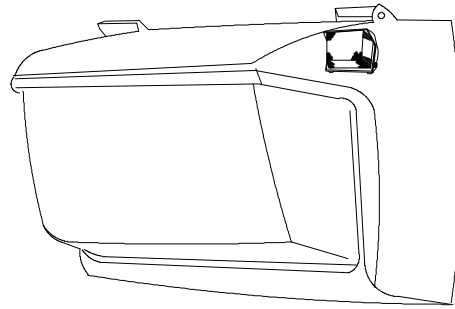
First Suffix	Second Suffix	Description
A		Rated for metal halide lamp
B		Rated for high pressure sodium lamp
	1	Type 300 emergency quartz standby

Fixture shall conform to UL 1572. The ballast housing and structural parts, including the mounting devices, shall be of cast aluminum. The optical assembly shall be enclosed, gasketed, and locked to the ballast housing by a positive vibration-proof means. An optical assembly filter to permit the passage of air during heating and cooling cycles shall be provided. All exposed cast aluminum parts shall have a baked enamel paint finish. The lens shall be heat and impact resistant glass mounted in a gasketed, hinged aluminum door frame. Ballast shall be of the high power factor type. Fixture shall be prewired. Ballast shall start and operate the lamp in an ambient temperature range of minus 20 degrees F to 105 degrees F. Metal halide fixture shall use a lead-peaked autotransformer ballast. High pressure sodium fixture shall use a regulated type ballast. Reflector shall be constructed of aluminum and contoured or formed to provide high lighting efficiency. The exterior of the reflector shall have a clear acrylic lacquer protective coating. The interior of the reflector shall be the manufacturer's standard commercial product finish suitable for light source provided. The fixture shall have a mogul base glazed porcelain lampholder, adjustable for varying the spacing-to-mounting-height ratio in the field. The fixture shall have separate, removable mounting components that can be easily removed and assembled to the structural or mounting hardware before mounting the remainder of the fixture. ++

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.



TYPE 501



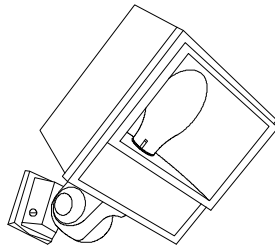
TYPE 502

High Intensity Discharge Fixture for Exterior Wall Mounting,  
Medium Output

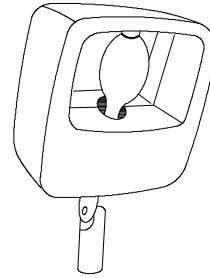
Suffix	Description
	Rated for:
A	50 watt high pressure sodium lamp
B	70 watt high pressure sodium lamp
C	100 watt high pressure sodium lamp
D	150 watt high pressure sodium lamp
E	175 watt metal halide lamp

Fixture shall conform to UL 1572 and shall be rated for use in wet locations. The fixture housing, door assembly, and backplate shall be die-cast aluminum. The door assembly shall have integral cast aluminum hinges. The door assembly shall be held securely to the fixture housing with a stainless steel safety strap when the door is in the open position. The door assembly shall be held firmly against a sealing gasket between the fixture door and housing by stainless steel latches or with stainless steel or brass captive screws when the fixture door is closed. The refractor shall be prismatic borosilicate glass or polycarbonate resin. The refractor shall be gasketed and securely held in the door frame, but shall be easily removed for replacement with a common tool. The reflector shall be aluminum with the manufacturer's standard commercial product finish suitable for the type and rating of the lamp. The fixture shall have manufacturers standard protective coating. Cast knockouts shall be provided in the backplate for recessed outlet box mounting. Ballast shall be of the high power factor type. Ballast shall be of the lead-peak autotransformer type metal halide for lamps and the regulating type for high pressure sodium lamps. Ballast shall be capable of starting and operating the lamp at ambient temperatures from minus 20 degrees F to 105 degrees F. The fixture shall be prewired, and shall have a field adjustable, mogul base glazed porcelain lampholder. ++

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.



TYPE 506  
Wall Bracket Mounting



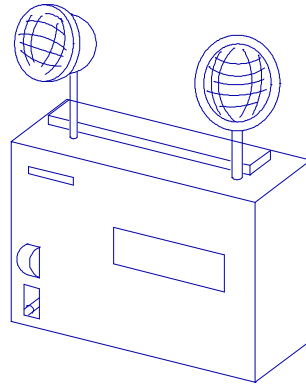
TYPE 507  
Slip Fitter Mounting

High Intensity Discharge Floodlight with Asymmetrical Light Distribution

First Suffix	Second Suffix	Third Suffix	Description
A			Rated for metal halide lamp
B			Rated for high pressure sodium (HPS) lamp
	1		NEMA type 6 x 5 light distribution
	2		NEMA type 7 x 7 light distribution
	3		NEMA type 7 x 6 light distribution
		A	Fixture with instant restrike feature
		B	Type 300 emergency unit

Fixture shall conform to UL 1572 and NEMA FA 1, and shall be the heavy-duty, enclosed type. Fixture shall consist of a cast aluminum housing and a cast aluminum door assembly and shall be integrally ballasted unless otherwise shown or approved. The door assembly shall be hinged and gasketed and held in a closed position with screws of finish to match fixture or recessed stainless steel latches. The lens shall be thermal shock and impact resistant tempered glass and shall be held securely in the door frame. Reflector shall be aluminum with manufacturer's standard commercial product finish suitable for light source provided. All metallic parts of the fixture shall receive one or more rust-inhibitive coatings prior to the application of interior and exterior finishes in accordance with the standard practice of the manufacturer for commercially available exterior lighting fixtures. Ballast shall be of the high power factor type capable of starting and operating the lamp in an ambient temperature of minus 20 degrees F to 105 degrees F. Ballast shall be of the lead-peak autotransformer type for metal halide lamps and the regulating type for high pressure sodium lamps. If an instant restrike feature is specified, the fixture shall be equipped to permit restarting of the lamp to full lumen output within 5 seconds following restoration of power after each momentary power interruption. The fixture shall be prewired and shall include a mogul base glazed porcelain lampholder. Mounting hardware for the fixture shall be adjustable, and shall be the cast aluminum type unless otherwise approved. ++

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.



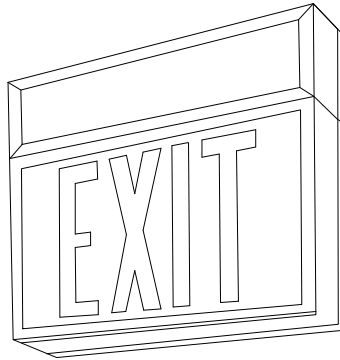
TYPE 602

## 6-Volt Emergency Battery Pack Unit with Two Floodlights

Unit shall conform to UL 924, NFPA 101, and shall meet or exceed the NFPA 70 time and voltage requirements. The unit shall be dual-rated for use on either 120-Volt or 277-Volt alternating current power supplies. The battery shall be the nickel-cadmium, pocket plate type designed to be maintenance free during the expected battery life, and shall be warranted for not less than eight years from the date of the purchase of the unit, and shall be field replaceable without requiring removal of other components. The battery charger shall be the solid-state type and shall provide a continuous, variable, current limited, filtered and regulated charge rate. The battery and charger shall be contained in a steel cabinet not less than 18 gauge thickness with an enamel finish, unless otherwise approved, which shall be equipped with a push-to-test switch and a meter to indicate battery voltage when the switch is closed. Mounting brackets or shelf shall be provided, complete with all mounting hardware, all with a finish to match the finish or color of the cabinet. The unit shall be prewired and equipped with two 6-volt, 5-8 watt floodlights as indicated. ++

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.





TYPE 604

## Exit Sign With Self-Contained Emergency Battery

First Suffix	Second Suffix	Third Suffix	Fourth Suffix *	Fifth Suffix	Description
A				1 - Steel	A - Red Lettering Single face
B				2 - Aluminum	B - Green Lettering Double face
		1		3 - Thermoplastic	End mounted
		2			Top mounted
		3			Back mounted
		4			Stem mounted
			A		Downlighting

\* The fourth suffix describes the unit housing. The thermoplastic housing shall meet UL 746C and UL 94V-0.

Fixture shall conform to UL 924, UL 1570, and NFPA 101. Concealed universal arrows shall be below or aligned with the center of the EXIT letters. The surface shall have a mat texture. The fixture shall have two compact fluorescent lamps, maximum of 10 watts each, normal mode and two DC incandescent lamps, maximum of 4 watts each. The contrast level of each letter shall be symmetrical with not less than 0.7 value, plus or minus 3 percent. The luminance output for normal and emergency mode will not be less than 70 cd/sq m. Fixture shall be NEMA rated for the environment. Provide a solid-state, current limiting regulated type battery charger with a nickle-cadmium maintenance free pocket plate type battery. Battery shall have, as a minimum, a eight year warranty. The fixture shall be warranted for three years. The battery shall be field replaceable without requiring removal of other components. The fixture shall have a light-emitting diode pilot light to indicate that the battery is fully charged. The fixture shall be prewired and shall be dual rated for 120-volt or 277-volt alternating power supplies. Wiring within the illuminated portion of the sign must be concealed ++

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.

## SECTION C-16665

### STATIC ELECTRICITY PROTECTION SYSTEM

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996) National Electrical Code
NFPA 77	(1993) Static Electricity
NFPA 780	(1997) Lightning Protection Systems

##### UNDERWRITERS LABORATORIES (UL)

UL 467	(1993) Grounding and Bonding Equipment
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##### 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-04 Drawings

Protection System; FIO.

Detail drawings consisting of a complete list of equipment and material, manufacturer's descriptive and technical literature, catalog cuts, wiring diagrams, and installation instructions. Drawings shall demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and mounting and relationship to other parts.

##### SD-09 Reports

Testing and Inspection; FIO.

Test data in booklet form, upon completion of installation of the system. The test report shall document all field tests performed and shall verify compliance with the specified performance criteria. Test data shall include the make, model and serial number of instruments used to conduct the test, and a certificate from an approved independent testing laboratory of meter calibration performed within 12 months of test.

##### 1.3 GENERAL REQUIREMENTS

###### 1.3.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work. No departures shall be made without the prior approval of the Contracting Officer.

###### 1.3.2 Rules

The installation shall conform to the applicable rules of NFPA 70.

## PART 2 PRODUCTS

### 2.1 MATERIAL AND EQUIPMENT

#### 2.1.1 General Requirements

Materials shall comply with the requirements of NFPA 77 and UL 467. No combination of materials shall be used that forms an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause deterioration of conductors, conductors with protective coatings or oversize conductors shall be used. Where a mechanical hazard is involved, the conductor size shall be increased to compensate therefor, or the conductors may be protected by covering them with molding or tubing made of wood or nonmagnetic material. When metallic conduit or tubing is used, the conductor shall be electrically connected at the upper and lower ends.

#### 2.1.2 Bonding Conductors

Conductors shall be of the uninsulated type. Conductor size shall be No. 6 AWG copper. Flexible or strap type copper conductors, with a thickness not less than No. 12 AWG and an electrical and mechanical equivalence of not less than No. 6 AWG, shall be used for bonding between moveable objects and connections which are disconnected frequently.

#### 2.1.3 Ground Rods (Electrodes)

Ground rods shall be of copper-clad steel, conforming to UL 467, not less than 3/4 inch in diameter by 10 feet in length.

#### 2.1.4 Static Ground Receptacles

Receptacles shall contain ground connection stud, housing cover and ground rod. Ground rods shall be interconnected below pavement or floor and connected to electrical service ground system via No. 6 AWG bare copper conductor.

#### 2.1.5 NOT USED

## PART 3 EXECUTION

### 3.1 INSTALLATION

The installation shall conform to the manufacturer's recommendations, except where otherwise specified.

#### 3.1.1 Static Grounding

Grounding conductors for static ground receptacles shall be connected to ground rods and interconnected as indicated. The static grounding system shall be connected below grade to the electrical power grounding system and any lightning-protection grounding system.

#### 3.1.2 Ground Rods

Ground rods shall be installed vertically in the earth until tops of rods are buried not less than 12 inches below finished grade.

#### 3.1.3 NOT USED

##### 3.1.3.1 Connections

Connections shall be made by brazing, welding, or with pressure-type ground clamps of not less than 8 square inches of contact area.

3.1.3.2 NOT USED

3.1.4 Grounding of Electrical Equipment

Electrical equipment shall be grounded as specified in Section C-16415 ELECTRICAL WORK, INTERIOR.

3.2 TESTING AND INSPECTION

3.2.1 Ground Resistance Testing

3.2.1.1 Ground Resistance Meter

Ground resistance shall be measured with bridge-type meter designed for testing grounds. The static electricity protection system will be deemed unsatisfactory if the resistance to ground exceeds 100 ohms.

3.2.1.2 Information Recorded

Soil conditions, weather, model and serial number of meter, date, and name of tester shall be recorded along with the resistance-to-ground readings of the protected equipment.

3.2.1.3 Notification

Tests shall be conducted in the presence of the Contracting Officer or his authorized representative. The Contracting Officer shall be notified 30 days before the performance and acceptance tests are to be conducted.

3.2.1.4 NOT USED

3.2.1.5 System Inspection

Conducting components, with the exception of grounding rods, shall not be concealed until inspected and accepted by the Contracting Officer.

-- End of Section --

## SECTION C-16670

### LIGHTNING PROTECTION SYSTEM

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### FEDERAL SPECIFICATION (FS)

FS W-S-610 (Rev E) Splice Connectors

##### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

NFPA 780 (1992) Lightning Protection Code

##### UNDERWRITERS LABORATORIES (UL)

UL-03 (1992) Electrical Construction  
Materials Directory

UL 96 (1985; Rev thru Dec 1988) Lightning  
Protection Components

UL 96A (1982; Rev thru Jul 1990) Installation  
Requirements for Lightning Protection Systems

UL 467 (1984; Rev thru Nov 1986) Grounding and  
Bonding Equipment

##### 1.2 GENERAL REQUIREMENTS

###### 1.2.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work. No departures shall be made without the prior approval of the Contracting Officer.

###### 1.2.2 System Requirements

The system furnished under this specification shall consist of the standard products of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer's latest UL approved design. The lightning protection system shall conform to NFPA 70 and NFPA 780, UL 96 and UL 96A, except where requirements in excess thereof are specified herein.

##### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Lightning Protection System; FIO.

Detail drawings consisting of a complete list of material, including manufacturer's descriptive and technical literature, catalog cuts, drawings, and installation instructions. Detail drawings shall demonstrate that the system has been coordinated and will function as a unit. Drawings shall show proposed layout and mounting and relationship to other parts of the work.

#### SD-13 Certificates

Materials and Equipment; FIO.

Where material or equipment is specified to comply with requirements of UL, proof of such compliance. The label or listing in UL-03 will be acceptable evidence. In lieu of the label or listing, a written certificate from an approved nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of Underwriters Laboratories may be submitted.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 General Requirements

No combination of materials shall be used that form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, conductors with protective coatings or oversize conductors shall be used. Where a mechanical hazard is involved, the conductor size shall be increased to compensate for the hazard or the conductors shall be protected by covering them with molding or tubing made of wood or nonmagnetic material. When metallic conduit or tubing is used, the conductor shall be electrically connected at the upper and lower ends.

#### 2.1.2 Main and Secondary Conductors

Conductors shall be in accordance with NFPA 780 and UL 96 for Class I, Class II, or Class II modified materials as applicable.

##### 2.1.2.1 Copper

Copper conductors used on nonmetallic stacks shall weigh not less than 375 pounds per thousand feet, and the size of any wire in the cable shall be not less than No. 15 AWG. The thickness of any web or ribbon used on stacks shall be not less than No. 12 AWG. Counterpoise shall be copper conductors not smaller than No. 1/0 AWG.

##### 2.1.2.2 Aluminum

Aluminum shall not contact the earth nor shall it be used in any other manner that will contribute to rapid deterioration of the metal. Appropriate precautions shall be observed at connections with dissimilar metals. Aluminum conductors for bonding and interconnecting metallic bodies to the main cable shall be at least equivalent to strength and cross-sectional area of a No. 4 AWG aluminum wire. If perforated strips are used, the strips shall be as much wider than solid strips, as the diameter of the perforations. Aluminum strip for connecting exposed water pipes shall be not less than No. 12 AWG in thickness and at least 1-1/2 inches wide.

#### 2.1.3 Air Terminals

Terminals shall be in accordance with UL 96 and NFPA 780. The tip of air terminals on buildings used for manufacturing, processing, handling, or storing

explosives, ammunition, or explosive ingredients shall be a minimum of 2 feet above the ridge parapet, ventilator or perimeter. On open or hooded vents emitting explosive dusts or vapors under natural or forced draft, air terminals shall be a minimum of 5 feet above the opening. On open stacks emitting explosive dusts, gases, or vapor under forced draft, air terminals shall extend a minimum of 15 feet above vent opening. Air terminals more than 24 inches in length shall be supported by a suitable brace, with guides, not less than one-half the height of the terminal.

#### 2.1.4 Ground Rods

Rods made of copper-clad steel shall conform to UL 467. Ground rods shall be not less than 3/4 inch in diameter and 10 feet in length. Ground rods of copper-clad steel, stainless steel, galvanized ferrous, and solid copper shall not be mixed on the job.

#### 2.1.5 Clamp-Type Connectors

Connectors for splicing conductors shall conform to UL 96, class as applicable, and FS W-S-610, Class 2, style and size as required for the installation.

#### 2.1.6 Lightning Protection Components

Lightning protection components, such as bonding plates, air terminal supports, chimney bands, clips, and fasteners shall conform to UL 96, classes as applicable.

### PART 3 EXECUTION

#### 3.1 INTEGRAL SYSTEM

##### 3.1.1 General Requirements

The lightning protection system shall consist of air terminals, roof conductors, down conductors, ground connections, and grounds, electrically interconnected to form the shortest distance to ground. All conductors on the structures shall be exposed except where conductors are in protective sleeves exposed on the outside walls. Secondary conductors shall interconnect with grounded metallic parts within the building. Interconnections made within side-flash distances shall be at or above the level of the grounded metallic parts.

##### 3.1.1.1 Air Terminals

Air terminal design and support shall be in accordance with NFPA 780. Terminals shall be rigidly connected to, and made electrically continuous with, roof conductors by means of pressure connectors or crimped joints of T-shaped malleable metal and connected to the air terminal by a dowel or threaded fitting. Air terminals at the ends of the structure shall be set not more than 2 feet from the ends of the ridge or edges and corners of roofs. Spacing of air terminals 2 feet in height on ridges, parapets, and around the perimeter of buildings with flat roofs shall not exceed 25 feet. In specific instances where it is necessary to exceed this spacing, the specified height of air terminals shall be increased not less than 2 inches for each foot of increase over 25 feet. On large, flat or gently sloping roofs, as defined in NFPA 780, air terminals shall be placed at points of the intersection of imaginary lines dividing the surface into rectangles having sides not exceeding 50 feet in length. Air terminals shall be secured against overturning either by attachment to the object to be protected or by means of a substantial tripod or other braces permanently and rigidly attached to the building or structure. Metal projections and metal parts of buildings, smokestacks, and other metal objects that do not contain hazardous materials and that may be struck but not appreciably damaged by lightning, need not be provided with air terminals. However, these metal objects shall be bonded



to the lightning conductor through a metal conductor of the same unit weight per length as the main conductor. Where metal ventilators are installed, air terminals shall be mounted thereon, where practicable. Any air terminal erected by necessity adjacent to a metal ventilator shall be bonded to the ventilator near the top and bottom thereof. Where nonmetallic spires, steeples, or ventilators are present, air terminals shall be mounted thereon or to the side. In addition, where spires or steeples project more than 10 feet above the building, the conductor between the air terminal and metal roof shall be continued to the nearest down conductor and securely connected thereto.

#### 3.1.1.2 Roof Conductors

Roof conductors shall be connected directly to the roof or ridge roll. Sharp bends or turns in conductors shall be avoided. Necessary turns shall have a radius of not less than 8 inches. Conductors shall preserve a downward or horizontal course and shall be rigidly fastened every 3 feet along the roof and down the building to ground. Metal ventilators shall be rigidly connected to the roof conductor at three places. All connections shall be electrically continuous. Roof conductors shall be coursed along the contours of flat roofs, ridges, parapets, and edges; and where necessary, over flat surfaces, in such a way as to join each air terminal to all the rest. Roof conductors surrounding tank tops, decks, flat surfaces, and flat roofs shall be connected to form a closed loop.

#### 3.1.1.3 Down Conductors

Down conductors shall be electrically continuous from air terminals and roof conductors to grounding electrodes. Down conductors shall be coursed over extreme outer portions of the building, such as corners, with consideration given to the location of ground connections and air terminals. Each building or structure shall have not less than two down conductors located as widely separated as practicable, at diagonally opposite corners. On rectangular structures having gable, hip, or gambrel roofs more than 110 feet long, there shall be at least one additional down conductor for each additional 50 feet of length or fraction thereof. On rectangular structures having French, flat, or sawtooth roofs exceeding 250 feet in perimeter, there shall be at least one additional down conductor for each 100 feet of perimeter or fraction thereof. On an L- or T-shaped structure, there shall be at least one additional down conductor; on an H-shaped structure, at least two additional down conductors; and on a wing-built structure, at least one additional down conductor for each wing. On irregularly shaped structures, the total number of down conductors shall be sufficient to make the average distance between them along the perimeter not greater than 100 feet. On structures exceeding 50 feet in height, there shall be at least one additional down conductor for each additional 60 feet of height or fraction thereof, except that this application will not cause down conductors to be placed about the perimeter of the structure at intervals of less than 50 feet. Additional down conductors shall be installed when necessary to avoid "dead ends" or branch conductors ending at air terminals, except where the air terminal is on a roof below the main protected level and the "dead end" or branch conductor is less than 16 feet in length and maintains a horizontal or downward coursing. Down conductors shall be equally and symmetrically spaced about the perimeter of the structure. Down conductors shall be protected where necessary, to prevent mechanical injury to the conductor.

#### 3.1.1.4 Interconnection of Metallic Parts

Metal doors, windows, and gutters shall be connected directly to the grounds or down conductors where required by NFPA 780 or UL 96A. Conductors placed where there is probability of unusual wear, mechanical injury, or corrosion shall be of greater electrical capacity than would normally be used, or shall be protected. The ground connection to metal doors and windows shall be by means of mechanical ties under pressure, or equivalent.

#### 3.1.1.5 Ground Connections

Ground connections comprising continuations of down conductors from the structure to the grounding electrode shall securely connect the down conductor and ground in a manner to ensure electrical continuity between the two. All connections shall be of the clamp type. There shall be a ground connection for each down conductor. Metal water pipes and other large underground metallic objects shall be bonded together with all grounding mediums. Ground connections shall be protected from mechanical injury. In making ground connections, advantage shall be taken of all permanently moist places where practicable, although such places shall be avoided if the area is wet with waste water that contains chemical substances, especially those corrosive to metal.

#### 3.1.1.6 Grounding Electrodes

A grounding electrode shall be provided for each down conductor located as shown. A driven ground shall extend into the earth for a distance of not less than 10 feet. Ground rods shall be set not less than 3 feet, nor more than 8 feet, from the structures foundation. The complete installation shall have a total resistance to ground of not more than 25 ohms if a counterpoise is not used. Ground rods shall be tested individually prior to connection to the system and the system as a whole shall be tested not less than 48 hours after rainfall. When the resistance of the complete installation exceeds the specified value or two ground rods individually exceed 50 ohms, the Contracting Officer will be notified immediately. A counterpoise, where required, shall be of No. 1/0 copper cable or equivalent material having suitable resistance to corrosion and shall be laid around the perimeter of the structure in a trench not less than 2 feet deep at a distance not less than 3 feet nor more than 8 feet from the nearest point of the structure. All connections between ground connectors and grounds or counterpoise, and between counterpoise and grounds shall be electrically continuous. Where so indicated on the drawings, an alternate method for grounding electrodes in shallow soil shall be provided by digging trenches radially from the building. The lower ends of the down conductors are then buried in the trenches.

#### 3.1.2 NOT USED

#### 3.1.3 NOT USED

#### 3.1.4 Steel Frame Building

The steel framework shall be made electrically continuous. Electrical continuity may be provided by bolting, riveting, or welding steel frame, unless a specific method is noted on the drawings. The air terminals shall be connected to the structural steel framework at the ridge. Short runs of conductors shall be used as necessary to join air terminals to the metal framework so that proper placing of air terminals is maintained. Separate down conductors from air terminals to ground connections are not required. Where a grounded metal pipe water system enters the building, the structural steel framework and the water system shall be connected at the point of entrance by a ground connector. Connections to pipes shall be by means of ground clamps with lugs. Connections to structural framework shall be by means of welding. All connections between columns and ground connections shall be made at the bottom of the steel columns. Ground connections to grounding electrons or counterpoise shall be run from not less than one-half of all the columns distributed equally around the perimeter of the structure at intervals averaging not more than 60 feet.

#### 3.1.5 THRU 3.1.9 NOT USED

#### 3.2 NOT USED

#### 3.3 NOT USED

### 3.4 INTERCONNECTION OF METAL BODIES

Metal bodies of conductance shall be protected if not within the zone of protection of an air terminal. All metal bodies of conductance having an area of 400 square inches or greater or a volume of 1000 cubic inches or greater shall be bonded to the lightning protection system using main size conductors and a bonding plate having a surface contact area of not less than 3 square inches. Provisions shall be made to guard against the corrosive effect of bonding dissimilar metals. Metal bodies of inductance shall be bonded at their closest point to the lightning protection system using secondary bonding conductors and fittings. A metal body that exceeds 5 feet in any dimension, that is situated wholly within a building, and that does not at any point come within 6 feet of a lightning conductor or metal connected thereto shall be independently grounded.

### 3.5 FENCES

Fences shall be grounded on each side of every gate. Fences shall be grounded by means of ground rods maximum of every 300 feet. The connection to ground shall be made from the post where it is of metal and is electrically continuous with the fencing.

### 3.6 NOT USED

### 3.7 NOT USED

### 3.8 NOT USED

### 3.9 INSPECTION

The lightning protection system will be inspected by the Contracting Officer to determine conformance with the requirements of this specification. No part of the system shall be concealed until so authorized by the Contracting Officer.

-- End of Section --

SECTION C-16721

FIRE DETECTION AND ALARM SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C135.30 (1988) Zinc-Coated Ferrous Ground Rods  
for Overhead or Underground Line Construction

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825 (1994; Supple 1) Approval Guide

FEDERAL STANDARDS (FED-STD)

FED-STD 595 (Rev B) Colors Used in Government  
Procurement

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991) Surge Voltages in Low-Voltage  
AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

NFPA 72 (1996) National Fire Alarm Code

NFPA 90A (1993) Installation of Air  
Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL-04 (1994) Fire Protection Equipment  
Directory

UL 6 (1993) Rigid Metal Conduit

UL 38 (1994; Rev Jan 1994) Manually  
Actuated Signaling Boxes for Use with  
Fire-Protective Signaling Systems

UL 268 (1989; Rev May 1989) Smoke Detectors for  
Fire Protective Signaling Systems

UL 268A (1983; Rev thru Mar. 1986) Smoke Detectors for  
Duct Application

UL 464 (1990) Audible Signal Appliances

UL 467 (1993) Grounding and Bonding  
Equipment

UL 521	(1993) Heat Detectors for Fire Protective Signaling Systems
UL 797	(1993) Electrical Metallic Tubing
UL 864	(1991; Rev thru May 1994) Control Units for Fire-Protective Signaling Systems
UL 1242	(1983; Rev thru Jul 1993) Intermediate Metal Conduit

## 1.2 GENERAL REQUIREMENTS

### 1.2.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours.

### 1.2.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

### 1.2.3 Keys and Locks

Locks shall be keyed alike.

### 1.2.4 Tags

Tags with stamped identification number shall be furnished for keys and locks.

### 1.2.5 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

### 1.2.6 Compliance

The fire detection and internal alarm system and the central reporting system shall be configured in accordance with NFPA 72. The equipment furnished shall be compatible and be UL listed or FM approved or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

### 1.2.7 Manufacturer's Services

Services of a manufacturer's representative who is experienced in the installation, adjustment, testing, and operation of the equipment specified shall be provided. The representative shall supervise the installation, adjustment, and testing of the equipment.

## 1.3 SYSTEM DESIGN

### 1.3.1 Operation

The fire alarm and detection system shall be a complete, supervised fire alarm system. The system shall be activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in the alarm mode until

initiating device is reset and the fire alarm control panel is reset and restored to normal. Alarm initiating devices shall be connected to initiating device circuits (IDC), Style D, in accordance with NFPA 72. Alarm indicating appliances shall be connected to indicating appliance circuits (IAC) in accordance with NFPA 72. A two-loop conduit system shall be provided so that if any one conduit and all conductors contained in that conduit are severed all IDC, IAC on that circuit shall remain functional. A two-loop system is not applicable to the central fire alarm communication center from the local panels. All textual, audible, and visual appliances and systems shall comply with NFPA 72 .

#### 1.3.2 Operational Features

The system shall have the following operating features:

a. Electrical supervision of alarm IDC and IAC. Smoke detectors shall have combined alarm initiating and power circuits.

b. Electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm zone module (card, PC board) within the control panel, and transmitter tripping circuit integrity.

c. Trouble buzzer and trouble lamp (light emitting diode or neon light) to activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage, removal of alarm zone module (card, PC board), and disconnection of the circuit used for transmitting alarm signals off-premises. A trouble alarm silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator lamp. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.

d. Transmitter disconnect switch to allow testing and maintenance of the system without activating the transmitter but shall provide a trouble signal when disconnected and a restoration signal when reconnected.

e. Evacuation alarm silencing switch or switches which, when activated, will silence alarm devices, but will not affect the zone indicating lamp nor the operation of the transmitter. This switch shall be over-ridden upon activation of a subsequent alarm from an unalarmed zone and the alarm devices will be activated.

f. Electrical supervision of circuits used for supervisory signal services. Supervision shall detect any open, short, or ground.

g. Confirmation or verification modules used on smoke detection initiating circuits. The modules shall interrupt the transmission of an alarm signal to the system control panel for a factory set period. This interruption period shall be adjustable from 1 to 60 seconds and be factory set at 20 seconds. Immediately following the interruption period, a confirmation period shall be in effect during which time an alarm signal if present will be sent immediately to the control panel. All fire alarm devices other than smoke detectors shall be prohibited on circuits controlled by confirmation or verification modules.

h. Zones for alarm IDC shall be arranged as indicated on the contract drawings.

#### 1.3.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

a. Transmission of a signal over the station radio fire reporting system. The signal shall be common for all zones.

b. Visual indications of the alarmed zones on the fire alarm control panel annunciator.

c. Continuous sounding of alarm notification appliances throughout the building.

d. Deactivation of the air handling units throughout the building.

#### 1.3.4 Primary Power

Operating power shall be provided as required by paragraph Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

#### 1.3.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. All submittals for government approval shall be submitted to Ft. Campbell Fire Prevention Division for approval. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-01 Data

Battery; FIO.

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

Voltage Drop; FIO.

Voltage drop calculations for signaling appliance circuits to indicate that sufficient voltage is available for proper appliance operation.

Spare Parts; FIO.

Spare parts data for each different item of material and equipment specified, not later than 3 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

Qualifications; FIO.

Qualifications, with verification of experience and license number, of a Registered Professional Engineer with at least 4 years of current experience in the design of the fire protection and detection systems. This engineer must perform the various specification items required by this section to be performed by a registered Professional Engineer.

##### SD-04 Drawings

Fire Alarm Reporting System; GA.

Detail drawings, signed by the Registered Professional Engineer, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical detectors. The contractor shall check the layout based on the actual detectors to be installed and make any necessary revisions in the detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit.

Detailed point-to-point wiring diagram, signed by the Registered Professional Engineer, showing all points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and all equipment that is activated or controlled by the panel.

#### SD-06 Instructions

Fire Alarm Reporting System; GA.

Six copies of operating instructions outlining step-by-step procedures required for system startup, operation, and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The instructions shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. Instructions shall be approved prior to training. Contractor shall provide a set of fire alarm schematic diagrams and O & M manual in the Mechanical Room located by the fire alarm control panel.

Training; FIO.

Lesson plans and training data, in manual format, for the training courses.

#### SD-08 Statements

Test Procedures; FIO.

Detailed test procedures, signed by the Registered Professional Engineer, for the fire detection and alarm system 60 days prior to performing system tests.

#### SD-09 Reports

Testing; FIO.

Test reports in booklet form showing all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document all readings, test results and indicate the final position of controls.

#### SD-13 Certificates

Equipment; GA.

Certified copies of current approvals or listings issued by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards.

Installer; FIO.



The Contractor shall provide documentation demonstrating that its fire detection and alarm system installer has been regularly engaged in the installation of fire detection and alarm systems meeting NFPA standards for a minimum of three years immediately preceding commencement of this contract. Such documentation shall specifically include proof of satisfactory performance on at least three projects similar to that required by these specifications, including the names and telephone numbers of using agency points of contact for each of these projects. Documentation shall indicate the type of each system installed and include a written certificate that each system has performed satisfactorily in the manner specified for a period of not less than 12 months following completion. All such data shall be submitted 30 days prior to commencement of installation for approval of the Contracting Officer. Listing of the installer under "Protective Signaling Services - Local, Auxiliary, Remote Station Proprietary (UUJS)" of UL-04 shall be accepted as equivalent proof of compliance with the foregoing experience requirements.

## 1.5 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, and any other contaminants.

## PART 2 PRODUCTS

### 2.1 CONTROL PANEL

Control Panel shall comply with all the applicable requirements of UL 864. Panel shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly assembled panel containing all components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic, phenolic or metal identification plates for all lamps, zones, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. Separate alarm and trouble lamp shall be provided for each zone alarm located on exterior of cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means shall be provided for testing the control panel visual indicating devices (meters or lamps). Meters and lamps shall be plainly visible when the cabinet door is closed. Signals shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system. Each IDC initiating circuit shall be powered and supervised so that a signal on one zone does not prevent the receipt of signals from other zones. Loss of power, including any or all batteries, shall not require the reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals.

Fire alarm control panel shall be coupled with Government Furnished Contractor Installed (GFCI) King Fisher Radio Alarm Transmitter (RAT) Interface Model Number KFRTI-WP-8 combination radio call box transmitter/interface panel.

#### 2.1.1 Visual Annunciators

Visual annunciators shall be provided for each active zone and spare zone. Spare zones shall be provided as shown on the drawing. Each lamp shall provide specific identification of the zone by means of a permanently attached rigid plastic, phenolic or metal sign with either raised or engraved letters. Zone identification shall consist of word description of the zone.

#### 2.1.2 Cabinets

Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate all units. All shall be painted red similar to FED-STD 595 color, number 11105.

#### 2.1.3 Remote System Trouble Audible/Visual Appliance

Audible appliance shall have a minimum sound level output rating of 85 dBA at 10 feet and operate in conjunction with the panel's integral trouble signal. The audible device shall be silenced by the system trouble silence switch. A rigid plastic, phenolic or metal identification sign which reads "Fire Alarm System Trouble" shall be provided at the audible appliance. The visual appliance located with the audible appliance shall not be extinguished until the trouble has been cleared.

#### 2.1.4 Circuit Connections

Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each terminal marked for identification.

### 2.2 STORAGE BATTERIES

Storage Batteries shall be provided and shall be the sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 48 hours. Following this period of operation via batteries, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Batteries shall be sized to deliver 50 percent more ampere/hours based on a 48 hour discharged rate than required for the calculated capacities. Battery cabinet shall be a separate cabinet. Battery shall be provided with overcurrent protection in accordance with NFPA 72.

### 2.3 BATTERY CHARGER

Battery charger shall be completely automatic, with high/low charging rate, capable of restoring the batteries from full discharge to full charge within 12 hours. A separate ammeter shall be provided for indicating rate of charge. A separate voltmeter shall be provided to indicate the state of the battery charge. A pilot light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly if a high rate switch is provided. Charger shall be located in control panel or battery cabinet.

### 2.4 MANUAL FIRE ALARM STATIONS

Manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be connected into alarm-initiating circuits. Stations shall be installed on surface mounted outlet boxes. Stations shall be double action type. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods are acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be painted the same color as the fire alarm manual stations.

## 2.5 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, and UL 521. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed. Detectors shall be connected into alarm initiating circuits. Detectors located in concealed locations (above ceiling, etc.) shall have a remote visible indicator lamp. Installed devices shall conform to the classification of the area.

### 2.5.1 Heat Detectors

Heat detectors shall be designed for detection of fire by combination fixed temperature and rate-of-rise principle. Heat detectors shall be rated for a minimum of 50 foot spacing (smooth-ceiling rated) in accordance with UL 521. Detectors located in areas subject to moisture, exterior atmospheric conditions or hazardous locations as defined by NFPA 70, shall be types approved for such locations. Heat detectors located in attic spaces or similar concealed spaces below the roof shall be intermediate temperature rated.

#### 2.5.1.1 Combination Fixed-Temperature and Rate-of-Rise Detectors

Detectors shall be designed for surface outlet box mounting and supported independently of wiring connections. Contacts shall be self-resetting after response to rate-of-rise principle. Under fixed temperature actuation, the detector shall have a permanent external indication which is readily visible. Detector units located in boiler rooms, showers, or other areas subject to abnormal temperature changes shall operate on fixed temperature principle only. Rating for fixed temperature portion shall be 135 degrees F in temperature conditioned spaces.

#### 2.5.1.2 NOT USED

#### 2.5.1.3 NOT USED

### 2.5.2 Smoke Detectors

Detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be ionization type. Detectors shall contain a visible indicator lamp that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Detectors shall be the plug-in type in which the detector base contains terminals for making all wiring connections. Detectors that are in concealed (above false ceilings, etc.) locations shall have a remote visible indicator lamp.

#### 2.5.2.1 Ionization Detectors

Ionization detectors with a dual chamber shall be responsive to both invisible and visible particles of combustion. One chamber shall be a reference chamber and the second a sampling chamber. Detectors containing radium shall not be provided. Detectors shall not cause an alarm condition due to anticipated fluctuations in relative humidity. The sensitivity of the detector shall be field adjustable to compensate for operating conditions. Detector shall require no replacement or readjustment to restore it to normal operation after an alarm condition. Each detector shall be capable of withstanding ambient air velocity up to 300 fpm in accordance with UL 268. Detectors shall have at least a two-stage sensitivity setting, with detectors initially set for normal sensitivity. A lower sensitivity shall be available for each detector. The lower sensitivity shall be within the limits established for that detector by UL or FM.

#### 2.5.2.2 NOT USED

#### 2.5.2.3 NOT USED

#### 2.5.2.4 Duct Smoke Detectors

Duct smoke detectors shall be provided in supply and return air ducts in accordance with NFPA 90A. Duct smoke detectors shall conform to the requirements of UL 268A. Duct smoke detectors shall have perforated sampling tubes extended into the air duct. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have manual reset. Detectors shall be rated for air velocities that include air flows between 500 fpm and 4000 fpm. Detectors shall be powered from the fire alarm control panel. Detectors shall have two sets of normally open alarm contacts and two sets of normally closed alarm contacts. Detectors shall be connected to the building fire alarm panel for alarm initiation. A remote annunciation lamp and accessible remote reset switch shall be provided for duct detectors that are mounted eight feet or more above the finished floor and for detectors that are not readily visible. Remote lamps and switches as well as the affected fan unit(s) shall be properly identified in etched rigid plastic placards.

#### 2.5.3 NOT USED

#### 2.5.4 NOT USED

### 2.6 NOTIFICATION APPLIANCES

Audible appliances shall be heavy duty and conform to the applicable requirements of UL 464. Devices shall be connected into alarm indicating circuits. All devices shall have a separate screw terminal for each conductor. All shall be painted red similar to FED-STD 595 color, number 11105.

#### 2.6.1 Alarm Bells

Bells shall be surface mounted with the matching mounting back box recessed. Bells shall be electrically operated suitable for use in an electrically supervised circuit. Bells shall be the underdome type producing a minimum output rating of 85 dBA at 10 feet. Bells used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grilles.

#### 2.6.2 Alarm Horns

Horns shall be surface mounted, double projector, grill and vibrating type suitable for use in an electrically supervised circuit. Horns shall produce a minimum sound rating of at least 85 dBA at 10 feet. Horns used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grills.

#### 2.6.3 NOT USED

#### 2.6.4 Visual Notification Appliances

Visual notification appliances shall have high intensity optic lens and flash tubes. Strobes shall flash at approximately 1 flash per second and a minimum of 1 candela (8,000 peak candle power). Strobe shall be surface mounted.

#### 2.6.5 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units except they shall mount as a unit in standard backboxes. All units shall be factory assembled. Any other audible indicating appliance employed in the fire alarm systems shall be approved by the authority having jurisdiction.

## 2.7 NOT USED

## 2.8 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

### 2.8.1 Ground Rods

Ground rods shall be of copper clad steel conforming to UL 467 not less than 3/4 inch in diameter by 10 feet in length.

### 2.8.2 NOT USED

### 2.8.3 Conduit

Conduit and fittings shall comply with UL 6, UL 1242 and UL 797.

### 2.8.4 Wiring

Wiring for 120V ac power shall be No. 12 AWG minimum. Wiring for low voltage dc circuits shall be No. 14 AWG minimum. Power wiring (over 28 volts) and control wiring shall be isolated. All wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except rigid plastic conduit may be used under slab-on-grade. All conductors shall be color coded. Conductors used for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to alarm initiating, supervisory circuits, and alarm indicating circuits are prohibited. T-tapping using screw terminal blocks is allowed for addressable systems.

### 2.8.5 Special Tools and Spare Parts

Special tools necessary for the maintenance, repair, or operation of the equipment shall be furnished and provided to Ft. Campbell DPW. Two spare fuses of each type and size required and five spare lamps and LED's of each type shall be furnished. Two percent of the total number of each different type of detector, but no less than two each, shall be furnished. Fuses and lamps shall be mounted in the fire alarm panel.

### 2.8.6 Radio Alarm Transmitter

A King Fisher Radio Alarm Transmitter (RAT) interface panel model KFRTI-WP8 shall be Government Furnished Contractor Installed (GFCI). The RAT shall communicate to, and be compatible with the Base Radio Alarm system.

### 2.8.7 Radio Antenna

A radio antenna compatible with the RAT shall be Government Furnished Contractor Installed (GFCI). Sizing and connection to the antenna shall be as required by the manufacturer.

## PART 3 EXECUTION

### 3.1 INSTALLATION

All work shall be installed as shown and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until the building has been thoroughly cleaned.

#### 3.1.1 Power Supply for the System

A single dedicated circuit connection for supplying power to each building fire alarm system shall be provided. The primary power shall be supplied as shown on

the drawings. The power supply shall be equipped with a locking mechanism and marked "FIRE ALARM CIRCUIT CONTROL".

### 3.1.2 Wiring

Wiring for systems shall be installed in 3/4 inch minimum diameter conduit. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. No more than one conductor shall be installed under any screw terminal. All circuit conductors entering or leaving any mounting box, outlet box enclosure or cabinet shall be connected to screw terminals with each terminal marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors are prohibited in the system. Wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

### 3.1.3 Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 12 inches nor more than 78 inches above the finished floor. All manually operable controls shall be between 36 inches to 42 inches above the finished floor. Panel shall be installed to comply with the requirements of UL 864.

### 3.1.4 Detectors

Detectors shall be installed in accordance with NFPA 72. Detectors shall be at least 12 inches from any part of any lighting fixture. Detectors shall be located at least 3 feet from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in free space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 3 feet, sway bracing shall be provided.

### 3.1.5 Notification Appliances

Notification appliances shall be mounted a minimum of 8 feet above the finished floor unless limited by ceiling height or otherwise indicated.

### 3.1.6 Annunciator Equipment

Annunciator equipment provided shall be mounted where indicated.

## 3.2 OVERVOLTAGE AND SURGE PROTECTION

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 and NFPA 70. All cables and conductors which serve as communications links, except fiber optics, shall have surge protection circuits installed at each end. Fuses shall not be used for surge protection.

## 3.3 GROUNDING

Grounding shall be provided to building ground or ground rods shall be driven. Maximum impedance to ground shall be 25 ohms. Ground rods shall not protrude more than 6 inches above grade.

### 3.4 TESTING

The Contractor shall notify the Contracting Officer 30 days before the preliminary and acceptance tests are to be conducted. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise all tests. The Contractor shall furnish all instruments and personnel required for the tests.

#### 3.4.1 Preliminary Tests

Upon completion of the installation, the system shall be subjected to functional and operational performance tests including tests of each installed initiating and notification appliance. Tests shall include the meggering of all system conductors to determine that the system is free from grounded, shorted, or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is functional.

#### 3.4.2 Acceptance Test

Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that all previous deficiencies have been corrected. The test shall include the following:

- a. Test of each function of the control panel.
- b. Test of each circuit in both trouble and normal modes.
- c. Tests of alarm initiating devices in both normal and trouble conditions.
- d. Tests of each control circuit and device.
- e. Tests of each alarm notification appliance.
- f. Tests of the battery charger and batteries.
- g. Complete operational tests under emergency power supply.
- h. Visual inspection of all wiring connections.
- i. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.
- j. Ground fault
- k. Short circuit faults
- l. Stray voltage
- m. Loop resistance

### 3.5 TRAINING

Training course shall be provided for the operations and maintenance staff. The course shall be conducted in the building where the system is installed or as designated by the Contracting Officer. The training period shall consist of 3 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover all of the items contained in the operating and maintenance instructions.

-- End of Section --

SECTION C-16741

TELEPHONE/INFORMATION SYSTEM, INSIDE PLANT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 68	Connection of Terminal Equipment to the Telephone Network
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ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA ANSI/TIA/EIA 568-A	(1995) Commercial Building Telecommunications Wiring Standard
EIA ANSI/TIA/EIA 569	(1990) Commercial Building Standard for Telecommunications Pathways and Spaces
EIA ANSI/TIA/EIA 606	(1993) Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
EIA ANSI/TIA/EIA 607	(1994) Grounding and Bonding Requirements for the Telecommunications Infrastructure of Commercial Buildings
EIA/TIA TSB 36	(1991) Additional Cable Specifications for Unshielded Twisted Pair Cables
EIA/TIA TSB 40A	(1994) Additional Transmission Specifications for Unshielded Twisted-Pair Connecting Hardware
EIA/TIA TSB 67	(1995) Transmission Performance Specifications for Field Testing of UTP Cabling Systems

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-80-576	(1994) ICEA Standard for Communications Wire and Cable for Wiring of Premises
ICEA S-83-596	(1994) ICEA Standard for Fiber Optic Premises Distribution Cable

INTERNATIONAL BUSINESS MACHINES CORPORATION (IBM)

IBM GA27-3361-07	(1987) LAN Cabling System - Planning and Installation
IBM GA27-3773-1	(1987) Cabling System Technical Interface Specification

INTERNATIONAL ELECTRO-TECHNICAL COMMISSION (IEC)



IEC 6037 (1993) Connectors for Frequencies Below 3 MHz  
for Use with Printed Boards Part 7: Detail  
Specification for Connectors, 8-Way, including  
Fixed and Free Connectors with Common Mating  
Features

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA VE 1 (1991) Metal Clad Tray Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

UNDERWRITERS LABORATORY (UL)

UL 50 (1995) Enclosures for Electrical Equipment

UL 1863 (1990) Standard for Safety, Communications  
Circuit Accessories

## 1.2 SYSTEM DESCRIPTION

The telephone/information system shall consist of inside-plant horizontal, riser, and backbone cables and connecting hardware to transport telephone and data (including LAN) signals between equipment items in the project buildings.

## 1.3 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 0 deg C to 60 deg C / 32 deg F to 140 deg F and in the range of 0% to 95% relative humidity, noncondensing.

## 1.4 MINIMUM CONTRACTOR AND MANUFACTURERS QUALIFICATIONS

### 1.4.1. Certification

All work under this section shall be performed by and all equipment shall be furnished and installed by a certified telecommunications contractor, hereafter referred to as the Contractor. With the exception of furnishing and installing conduit, electrical boxes, and pullwires, this work shall not be done by the electrical contractor. The Contractor shall have the following qualifications in Telecommunications System installation:

a. Contractor shall have a minimum of 3 years experience in the application, installation and testing of the specified systems and equipment.

b. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products. General electrical trade staff (electricians) shall not be used for the installation of the premises distribution system cables and associated hardware.

c. All installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components.

#### 1.4.2 Minimum Manufacturer Qualifications

The equipment and hardware provided under this contract will be from manufacturers that have a minimum of 3 years experience in producing the types of systems and equipment specified.

#### 1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-01 Data

Telephone System; FIO.

Equipment calculations for such items as line cards, trunk cards, and memory. Traffic calculations indicating the system capacity in hundred call seconds (CCS) of proposed equipment versus requirement in CCS of proposed line and trunk capacities. Requirements for ac and dc power, battery, and charger sizing calculations.

Spare Parts; FIO.

Lists of spare parts, tools, and test equipment for each different item of material and equipment specified, after approval of detail drawings, not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

##### SD-04 Drawings

Telephone/Information System; GA.

Detail drawings including a complete list of equipment and material. Detail drawings shall contain complete wiring and schematic diagrams and other details required to demonstrate that the system has been coordinated and will function properly as a system. Drawings shall include vertical riser diagrams, equipment rack details, elevation drawings of telecommunications closet walls, outlet face plate details for all outlet configurations, sizes and type of all cables, conduits, and cable trays. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation. System drawings and records showing final configuration, including location, type, block, panel and terminal assignment of cabling in accordance with EIA/TIA 606, and floor plan layout of the equipment room.

##### SD-06 Instructions

Manufacturers' Recommendations; GA.

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations, prior to installation shall be provided. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

#### SD-08 Statements

Test Plan; GA.

Test plan defining all tests required to ensure that the system meets technical, operational and performance specifications, 60 days prior to proposed test date. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested, and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

Qualifications; GA.

The qualifications of the Manufacturer(s), Contractor(s) and the Installer(s) to perform the work specified herein. This shall include proof of the minimum qualifications specified herein.

#### SD-09 Reports

Test Reports; FIO.

Test reports, in booklet form with witness signatures verifying execution of tests. Test results will also be provided on 3-1/2 inch diskettes in MSWord 6 format. Reports shall show the field tests performed to verify compliance with the specified performance criteria. Test reports shall include record of the physical parameters verified during testing. These reports shall be submitted within 14 days after completion of testing.

#### SD-13 Certificates

Telephone/Information Systems; GA.

Written certification that the telephone/information system fully complies with the EIA/TIA 568, 569, 606, TSB 36 and TSB 40A standards.

Materials and Equipment; GA.

Where materials or equipment are specified to conform, be constructed or tested to meet specific requirements, the Contractor shall submit certification that the items provided conform to such requirements. Certification by a nationally recognized testing laboratory that a representative sample has been tested to meet the requirements, or a published catalog specification statement to the effect that the item meets the referenced standard, will be acceptable as evidence that the item conforms. Compliance with these requirements does not relieve the Contractor from compliance with other requirements of the specifications.

Installers: GA.

The Contractor shall submit certification that all the installers are factory certified to install and test the provided products.

#### SD-19 Operations and Maintenance Manuals

Manufacturer's Manuals; FIO.

Commercial off the shelf manuals for operation, installation, configuration, and maintenance for all products provided as a part of the premises distribution system. Specification sheets for all cable, connectors, and other equipment.

## 1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust or other contaminants.

## PART 2 PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 1 year prior to installation. Materials and equipment shall conform to the respective publications and other requirements specified below and to the applicable requirements of NFPA 70.

### 2.2 UNSHIELDED TWISTED PAIR CABLE SYSTEM

#### 2.2.1 Riser Cable

Cable shall meet the requirements of ICEA S-80-576 and EIA/TIA 568 and EIA/TIA TSB 36 for Category 3 100-ohm unshielded twisted pair cable. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Conductors shall be solid un-tinned copper 24 AWG. Cable shall be rated CMR or CMP, as appropriate, per NFPA 70.

#### 2.2.2 Horizontal Cable

Copper station cables shall be ICEA S-80-576, type one, 24 AWG, four pairs of continuous manufacture with no splices. Cable shall meet the requirements of EIA/TIA 568 and EIA/TIA TSB 36 for Category 3 or 5 (as shown) horizontal cable. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Conductors shall be solid un-tinned copper 24 AWG. Cable shall be rated CMG or CMP, as appropriate, per NFPA 70.

#### 2.2.3 Connecting Hardware

Connecting and cross-connecting hardware shall be the same category as the cable it serves. Hardware shall be in accordance with EIA/TIA 568 and EIA/TIA TSB 40A.

##### 2.2.3.1 Telecommunications Outlets

Administration area outlet plates shall come equipped with two modular 8 position jacks, with the top or left jack labeled "voice" and the bottom or right jack labeled "data" and two fiber optic ST type connectors with the top or left connector labeled "XMT" and the bottom or right connector labeled "RCV". Wall phone outlet plates shall come equipped with one modular 8 position jacks and appropriate mounting lugs. Modular jacks shall be the same category as the cable they terminate and shall meet the requirements of EIA/TIA 568 and EIA/TIA TSB 40A. Modular jack pin/pair configuration shall be T568A per EIA/TIA 568 and EIA/TIA TSB 40A. Modular jacks shall be unkeyed. Faceplates shall be provided and shall be ivory in color, impact resistant plastic, double gang. Outlet assemblies used in the premises distribution system shall consist of modular jacks assembled into both simplex and duplex outlet assemblies as specified in this section and as indicated on the drawings. The modular jacks shall conform to the requirements of EIA/TIA 568 and EIA/TIA TSB 40A for Category 3 and 5 as shown; IEC 6037 Part 7; NFPA 70; FCC CFR 47, Part 68, Subpart F; and UL 1763.

#### 2.2.3.2 Patch Panels

Patch panels shall consist of eight-position modular jacks, with rear mounted type 110 insulation displacement connectors, arranged in rows or columns on 480mm (19 inch) rack mounted panels. Jack pin/pair configuration shall be T568A per EIA/TIA 568 and EIA/TIA TSB 36. Jacks shall be unkeyed. Panels shall be labeled with alphanumeric x-y coordinates. Panels shall conform to the requirements of EIA/TIA 568 and EIA/TIA 40A for Category 5.

#### 2.2.3.3 Patch Cords

Patch cords shall be cable assemblies consisting of flexible, twisted pair stranded wire with eight-position plugs at each end. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Patch cords shall be wired straight through; pin numbers shall be identical at each end and shall be paired to match T568A patch panel jack wiring per EIA/TIA 568 and EIA/TIA TSB 40A. Patch cords shall be unkeyed. Patch cords shall be factory assembled, and shall conform to the requirements of EIA/TIA 568 and EIA/TIA 40A for Category 5.

#### 2.2.3.4 Terminal Blocks

Terminal blocks shall be wall mounted wire termination units consisting of insulation displacement connectors mounted in plastic blocks, frames or housings. Blocks shall be type 110 which meet the requirements of EIA/TIA 568 and EIA/TIA TSB 40A for Category 3 or 5 as shown. Blocks shall be mounted on standoffs and shall include cable management hardware. Insulation displacement connectors shall be plated, shall terminate 22 or 24 gauge solid copper wire as a minimum, and shall be connected in pairs so that horizontal cable and connected jumper wires are on separate connected terminals.

#### 2.3 NOT USED

#### 2.4 NOT USED

#### 2.5 NOT USED

#### 2.6 FIBER OPTIC CABLE SYSTEM

##### 2.6.1 Backbone Cable

###### 2.6.1.1 NOT USED

###### 2.6.1.2 Singlemode

Singlemode fiber optic backbone cable shall meet the requirements of ICEA S-83-596 and the following: operation at a center wavelength of 1310 nm and 1550 nm; core/cladding diameter 8.3 nominal/125 micrometer (8.3/125 :m); maximum attenuation 2.0 dB/km at 1300 nm, 1.75 db/km at 1550 nm. Numerical aperture for each fiber shall be a minimum of 0.10. Cable construction shall be tight buffered type. Cable shall be imprinted with fiber count and aggregate length at regular intervals. Individual fibers shall be color coded for identification. Cable shall be rated OFNR, OFNP, OR OFNG, as appropriate, per NFPA 70.

##### 2.6.2 Horizontal Distribution Cable

###### 2.6.2.1 Multimode

Multimode fiber optic horizontal cable shall meet the requirements of EIA/TIA 568 and ICEA S-83-596 for 62.5/125 micrometer (62.5/125 :m] multimode graded index

optical fiber cable. Numerical aperture for each fiber shall be a minimum of 0.275. Cable construction shall be tight buffered type, two strands. Individual fibers shall be color coded for identification. Cable shall be imprinted with fiber count, fiber type, and aggregate length at regular intervals of 2 feet. Cable shall be rated and marked OFNP or OFNG, as appropriate, per NFPA 70.

#### 2.6.2.2 NOT USED

### 2.6.3 Connecting Hardware

#### 2.6.3.1 Connectors

Connectors shall be ST type with ceramic ferrule material with a maximum insertion loss of .5 dB. Connectors shall meet performance requirements of EIA/TIA 568. Connectors shall be field installable. Connectors shall utilize adhesive for fiber attachment to ferrule. Connectors shall terminate fiber sizes as required for the service. Station cable faceplates shall be provided and shall be ivory in color, impact resistant plastic, single gang, with double-sided female ST coupler.

#### 2.6.3.2 Patch Panels

Patch panels shall be a complete system of components by a single manufacturer, and shall provide termination, splice storage, routing, radius limiting, cable fastening, storage, and cross-connection. Patch panels shall be 480 mm (19 inch) rack mounted panels. Patch panels shall provide strain relief for cables. Panels shall be labeled with alphanumeric x-y coordinates. Patch panel connectors and couplers shall be the same type and configuration as used elsewhere in the system.

#### 2.6.3.3 Patch Cords

Patch cords shall be cable assemblies consisting of flexible optical fiber cable with connectors of the same type as used elsewhere in the system. Optical fiber shall be the same type as used elsewhere in the system. Patch cords shall be complete assemblies from manufacturer's standard product lines.

### 2.7 EQUIPMENT RACKS

#### 2.7.1 Floor Mounted Open Frame

Floor mounted equipment racks shall be welded steel relay racks with uprights to mount equipment 480 mm (19 inches) wide. Uprights shall be 3 inch deep channel, 1-1/4 inches wide, drilled and tapped 12-24 in a 1/2 inch pattern. Racks shall be provided with a standard top crossmember, and pre-drilled base plate to allow floor fastening. Open frame equipment racks shall be 7 feet in height and clear coated. AC outlets shall be provided as shown.

#### 2.7.2 NOT USED

#### 2.7.3 Cable Guides

Cable guides shall be specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on 480 mm (19 inch) wide equipment racks. Cable guides shall consist of ring or bracked-like devices mounted on rack panels for horizontal use or individually mounted for vertical use. Cable guides shall mount to racks by screws and/or nuts and lock-washers.

#### 2.7.4 NOT USED

#### 2.7.5 Wall Mounted/Ceiling Mounted Cabinets

Wall mounted cabinets shall conform to UL 50 and have boxes constructed of zinc-coated sheet steel with dimensions not less than shown on drawings. Trim shall be fitted with hinged door and flush catch. Doors shall provide maximum openings to the box interiors. Boxes shall be provided with 19 mm (3/4 inch) plywood backboard painted white or a light color, when wall mounted.

#### 2.8 EQUIPMENT MOUNTING BACKBOARD

Plywood backboards shall be provided, sized as shown, painted with white or light colored paint.

#### 2.9 TELECOMMUNICATIONS OUTLET BOXES

Electrical boxes for telecommunication outlets shall be 4-11/16 inch square by 2-1/8 inch deep with minimum 3/8 inch deep single or two gang plaster ring as shown. Provide a minimum 1 inch conduit.

#### 2.10 SPECIAL TOOLS

Any special tools or peripheral equipment required to repair, operate, maintain or program telephone/information system equipment shall be provided to Ft. Campbell DPW.

#### 2.11 CABLE TRAYS

NEMA VE 1 cable trays shall form a wireway system, and shall be of nominal 6 inch depth. Cable trays shall be constructed of aluminum. Trays shall include splice and end plates, dropouts, and miscellaneous hardware. Edges, fittings, and hardware shall be finished free from burrs and sharp edges. Fittings shall have not less than the load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius. Radius of bends shall be 24 inches.

##### 2.11.1 Ladder

Ladder-type cable trays shall be of nominal 12 inch width. Rung spacing shall be on 6 inch maximum centers.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

System components and appurtenances shall be installed in accordance with NFPA 70, manufacturer's instructions and as shown. Necessary interconnections, services, and adjustments required for a complete and operable signal distribution system shall be provided. Components shall be labeled in accordance with EIA/TIA 606. Penetrations in fire-rated construction shall be fire-stopped in accordance with Section 07270 FIRESTOPPING. Conduits, outlets and raceways shall be installed in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Wiring shall be installed in accordance with EIA/TIA 568 and as specified in Section 16415 ELECTRICAL WORK, INTERIOR. EIA/TIA 568, Appendix C, or an approved alternative, shall be considered mandatory. Cables shall not be installed in the same cable tray, utility pole compartment, or floor trench compartment with AC power cables. Cables not installed in conduit or wireways shall be properly secured and neat in appearance.

### 3.1.1 Horizontal Distribution Cable

The rated cable pulling tension shall not be exceeded. Cable shall not be stressed such that twisting, stretching or kinking occurs. Cable shall not be spliced. Copper cable, not in a wireway, shall be suspended a minimum of 200 mm (8 inches) above ceilings by cable supports no greater than 1.5 meters (60 inches) apart. Fiber optic cable will be provided with continuous support along its placement path avoiding point stress loads. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 300 mm (12 inches) shall be maintained when such placement cannot be avoided. Cables shall be terminated; no cable shall contain unterminated elements. Minimum bending radius shall not be exceeded during installation or once installed. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered. In raised floor areas, cable shall be installed after the flooring system has been installed. Provide 1.8 meters (6 feet) of cable shall be neatly coiled not less than 300 mm (12 inches) in diameter below each feed point in raised floor areas.

### 3.1.2 Riser and Backbone Cable

Vertical cable support intervals shall be per manufacturers recommendations. Cable bend radius shall not be less than ten times the outside diameter of the cable during installation and once installed. Maximum tensile strength rating of the cable shall not be exceeded. Cable shall not be spliced.

### 3.1.3 Telecommunications Outlets

#### 3.1.3.1 Faceplates

As a minimum, each jack shall be labeled as to its function and a unique number to identify cable link.

#### 3.1.3.2 Cables

Unshielded twisted pair and fiber optic cables shall have a minimum of 6 inches of slack cable loosely coiled into the telecommunications outlet boxes. Minimum manufacturers bend radius for each type of cable shall not be exceeded.

#### 3.1.3.3 Pull Cords

Pull cords shall be installed in all conduit serving telecommunications outlets which do not initially have fiber optic cable installed.

### 3.1.4 Terminal Blocks

Terminal blocks shall be mounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Industry standard wire routing guides shall be utilized.

### 3.1.5 Unshielded Twisted Pair Patch Panels

Patch panels shall be mounted in equipment racks with sufficient modular jacks to accommodate the installed cable plant plus ten percent (10%) spares. Cable guides shall be provided above, below and between each panel.



### 3.1.6 Fiber Optic Patch Panels

Patch Panels shall be mounted in equipment racks with sufficient ports to accommodate the installed cable plant plus ten percent (10%) spares. A slack loop of fiber shall be provided within each panel. Loop shall be 900 mm (3 feet). The outer jacket of each cable entering a patch panel shall be secured to the panel to prevent movement of the fibers within the panel, using clamps or brackets specifically manufactured for that purpose.

### 3.1.7 Equipment Racks

Open frame equipment racks shall be bolted to the floor. Cable guides shall be bolted or screwed to racks. Racks shall be installed level. Ganged racks shall be bolted together. Ganged rack cabinets shall have adjacent side panels removed. Wall mounted racks shall be secured to the mounting surface to prevent fully loaded racks from separating from the mounting surface.

### 3.1.8 Rack Mounted Equipment

Equipment to be rack mounted shall be securely fastened to racks by means of the manufacturer's recommended fasteners.

### 3.1.9 Conduit

Category 5 cable and conduit for Category 5 cable shall be installed by the same contractor.

### 3.1.10 Cable Trays

Cable trays shall be supported in accordance with the recommendations of the manufacturer but at no more than 6 foot intervals. Contact surfaces of aluminum connections shall be coated with an antioxidant compound prior to assembly. Adjacent cable tray sections shall be bonded together by connector plates of an identical type as the cable tray sections. The Contractor shall submit the manufacturer's certification that the cable tray system meets all requirements of Article 318 of NFPA 70. The cable tray shall be installed and grounded in accordance with the provisions of Article 318 of NFPA 70. Data submitted by the Contractor shall demonstrate that the completed cable tray systems will comply with the specified requirements. Cable trays shall terminate 10 inches from both sides of smoke and fire partitions. Conductors run through smoke and fire partitions shall be installed in 12 inches beyond each side of the partitions. The installation shall be sealed to preserve the smoke and fire rating of the partitions. Penetrations shall be firestopped in accordance with Section C-07270 FIRESTOPPING.

## 3.2 TERMINATION

Cables and conductors shall sweep into termination areas; cables and conductors shall not bend at right angles. Manufacturer's minimum bending radius shall not be exceeded. When there are multiple system type drops to individual workstations, relative position for each system shall be maintained on each system termination block or patch panel.

### 3.2.1 Unshielded Twisted Pair Cable

Each pair shall be terminated on appropriate outlets, terminal blocks or patch panels. No cable shall be unterminated or contain unterminated elements. Pairs shall remain twisted together to within the proper distance from the termination as specified in EIA/TIA TSB 40A. Conductors shall not be damaged when removing insulation. Wire insulation shall not be damaged when removing outer jacket.

### 3.2.2 NOT USED

### 3.2.4 Fiber Optic Cable

Each fiber shall have connectors installed. The pull strength between the connector and the attached fiber shall be not less than 1.3 kg (25 pounds). The mated pair loss, without rotational optimization, shall not exceed 1.5 dB. Fiber optic connectors shall be installed per EIA/TIA 568.

### 3.3 GROUNDING

Signal distribution system ground shall be installed in the telecommunications entrance facility and in each telecommunications closet in accordance with EIA/TIA 607 and Section 16415 ELECTRICAL WORK, INTERIOR. Equipment racks shall be connected to the electrical safety ground.

### 3.4 ADDITIONAL MATERIALS

The Contractor shall provide the following additional materials required for facility startup.

- a. 10 of each type outlet.
- b. 10 of each type cover plate.
- c. 1 of each type terminal block for each telecommunications closet.
- d. 4 patch cords of 10 feet for each telecommunications closet.
- e. 1 set of any and all special tools required to establish a cross connect and to change and/or maintain a terminal block.

### 3.5 TRAINING

#### 3.5.1 PRE-OPERATIONAL TRAINING

Operation and Maintenance: After inspection and before placing the equipment in operation, the Contractor shall provide separate operation and training courses for a maximum of 3 Government personnel in the operation and maintenance of the system. The 2 training courses shall be conducted by the manufacturer of the equipment and shall be conducted at the project site. The training shall include operation and troubleshooting of the system. The Contractor shall provide for text, workbooks, pamphlets, and written instruction required for the training. The Contractor shall arrange for classrooms, training instructors, and other miscellaneous items required for the training. The training shall cover a minimum of 10 working days and shall include hands-on experience in laboratories as well as classroom instruction. Training days shall be 8 hours a day.

#### 3.5.2 USER TRAINING

After the system is installed and ready for use, and prior to cutover, the Contractor shall conduct detailed training sessions covering orientation for 3 Government personnel. The orientation, as a minimum, shall include an explanation of basic principles, theory, and structure of the system, as well as demonstrations of equipment operations. The Contractor shall provide onsite training personnel for a 2-week period after system cutover.

### 3.6 TESTING

#### 3.6.1 Unshielded Twisted Pair Tests

All metallic cable pairs shall be tested for proper identification and continuity. All opens, shorts, crosses, grounds, and reversals shall be corrected. Correct color coding and termination of each pair shall be verified in the communications closet and at the outlet. Horizontal wiring shall be tested from and including the termination device in the communications closet to and including the modular jack in each room. Backbone wiring shall be tested end-to-end, including termination devices, from terminal block to terminal block, in the respective communications closets. These tests shall be completed and all errors corrected before any other tests are started. Twenty-five percent (25%) of the installed Category 3 circuits, selected on a random basis, and all Category 5 circuits shall be tested to demonstrate Category 3 or 5, as appropriate, performance.

#### 3.6.2 NOT USED

#### 3.6.3 NOT USED

#### 3.6.4 Fiber Optic Cable

Unless stated otherwise, tests shall be performed from both ends of each circuit. Connectors shall be visually inspected for scratches, pits or chips and shall be re-terminated if any of these conditions exist. Each circuit leg and complete circuit shall be tested for insertion loss at 850 and 1300 or 1310 and 1550 nanometers, according to mode of cable, using a light source similar to that used for the intended communications equipment. High-resolution optical time domain reflectometer (OTDR) tests shall be performed from one end of each fiber. Scale of the OTDR trace shall be such that the entire circuit appears over a minimum of eighty percent (80%) of the X-axis.

-- End of Section --

## SECTION C-16742

### TELEPHONE/INFORMATION SYSTEM, OUTSIDE PLANT

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

#### AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2 (1996) National Electrical Safety Code

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 228 (1993) Steel Wire, Music Spring Quality  
ASTM C 338 (1993) Softening Point of Glass  
ASTM D 2239 (1994) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

#### ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA ANSI/EIA/TIA 455-3 (May 1981) FOTP-25 Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices - Addendum No. 3 to EIA 455  
EIA ANSI/EIA/TIA 455-5 (Sep 1982) Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices - Addendum No. 5 to EIA 455  
EIA ANSI/EIA/TIA 455-25B (1996) FOTP-25 Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies  
EIA ANSI/EIA/TIA 455-41A (1993) FOTP-41 Compressive Loading Resistance of Fiber Optic Cables  
EIA ANSI/EIA/TIA 455-46A (1990) FOTP-46 Spectral Attenuation Measurement for Long-Length, Graded-Index Optical Fibers  
EIA ANSI/EIA/TIA 455-47B (1992) FOTP-47 Output Far Field Radiation Pattern Measurement  
EIA ANSI/EIA/TIA 455-51A (1991) FOTP-51 Pulse Distortion Measurement of Multimode Glass Optical Fiber Information Transmission Capacity  
EIA ANSI/EIA/TIA 455-53A (1990) FOTP-53 Attenuation by Substitution Measurement for Multimode Graded-Index Optical Fibers or Fiber Assemblies Used in Long Length Communications Systems

EIA ANSI/EIA/TIA 455-54A	(1990) FOTP-54 Mode Scrambler Requirements for Overfilled Launching Conditions to Multimode Fibers
EIA ANSI/EIA/TIA 455-65	(1988) FOTP-65 Optical Fiber Flexure Test
EIA ANSI/EIA/TIA 455-81A	(1992) FOTP-81 Compound Flow (Drip) Test for Filled Fiber Optic Cable
EIA ANSI/EIA/TIA 455-103	(Jul 1984) FOTP-103 Buffered Fiber Bend Test

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-56-434	(1983; R 1991) Polyolefin Insulated Communication Cables for Outdoor Use
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996) National Electrical Code
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RURAL ELECTRIFICATION ADMINISTRATION (REA)

REA Bulletin 344-2	(Jan 1989); Supplements 1 thru 8, List of Materials Acceptable for Use on Telephone Systems of REA Borrowers
REA Bulletin 1755I-100	(1991; Rev thru Supple 11 Nov 92) List of Materials Acceptable for Use on Telephone Systems of REA Borrowers
REA Form 522	(1993) General Specification for Digital, Stored Program Controlled Central Office Equipment
REA PC-2	(1995) Splicing Plastic-Insulated Cables
REA PC-4	(1976) Acceptance Tests and Measurements of Telephone Plant
REA PE-22	(1982) Aerial and Underground Telephone Cable
REA PE-33	(1985) Shield Bonding Connectors
REA PE-39	(1993) Filled Telephone Cables
REA PE-60	(1979) Trunk Carrier Systems
REA PE-74	(1985) Filled Splice Closures
REA PE-87	(1994) Terminating (TIP) Cable
REA PE-89	(1993) Filled Telephone Cables with Expanded Insulation
REA TE&CM 635	(1988; Addenda 1 thru 4) Construction of Aerial Cable Plant

REA TE&CM 641 (1973) Construction of Buried Plant

REA TE&CM 644 (1983) Design and Construction of  
Underground Cable (Physical Plant)

REA TE&CM 823 (1980; R Aug 1990) Electrical Protection by Use  
of Gas Tube Arrestors

UNDERWRITERS LABORATORIES (UL)

UL 497 (1995; Rev thru May 1996) Protectors for  
Paired Conductor Communication Circuits

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-01 Data

Spare Parts; FIO.

Data lists of spare parts, tools, and test equipment for each different item of material and equipment specified, after approval of the detail drawings and not later than 3 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

SD-04 Drawings

Telephone System; GA.

Detail drawings consisting of a complete list of equipment and material including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts and installation instructions. Detail drawings shall also contain complete wiring and schematic diagrams and any other details required to demonstrate that the cable system has been coordinated and will properly support the switching and transmission systems identified in the specification and drawings. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operations. System drawings showing final configuration, including the location, gauge, pair, duct and innerduct arrangement, or conductor assignment of outside plant, and protector and connector blocks layout at the termination points after installation.

SD-08 Statements

Test Plans; GA.

Test plans shall define all tests required to ensure that the system meets specified required. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested.

SD-09 Reports

Acceptance Tests; FIO.

Test reports in booklet form showing all field tests performed, upon completion and testing of the installed system.

Installation Procedures; GA.

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations, prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

#### SD-13 Certificates

Where materials or equipment are specified to conform to the standards or publications and requirements of FCC, REA, ANSI, ASTM, NFPA, EIA, or UL, proof that the items furnished under this section of the specification conform to the specified requirements.

### 1.3 DELIVERY AND STORAGE

All cable shall be shipped on reels. The diameter of the drum shall be at least 13 times the diameter of the cable. The reels shall be substantial and so constructed as to prevent damage during shipment and handling. The outer end of the cable shall be securely fastened to the reel head so as to prevent the cable from becoming loose in transit. The inner end of the cable shall project into a slot in the side of the reel, or into a housing on the inner slot of the drum, in such a manner and with sufficient length to make it available for testing. The inner end shall be fastened so as to prevent the cable from becoming loose during installation. End seals shall be applied to each of the cables to prevent moisture from entering the cable. The reels with cable shall be suitable for outside storage conditions when the temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from 0 to 100 percent. Equipment, other than cable, delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, or other contaminants.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 2 years prior to bid opening. Each major component of equipment shall have the manufacturer's name and type identified on the equipment.

### 2.2 DISTRIBUTION FRAME

#### 2.2.1 NOT USED

#### 2.2.2 Copper Conductor Type, Building Distribution Frame (BDF)

The BDF shall consist of a self-contained wall unit providing a field cable stub, housing for termination and protector modules, and access for cross-connecting to inside wiring.

##### 2.2.2.1 Protector Modules

The protector modules shall be of the three-electrode gas tube type. Protection modules shall be classified as light, medium, heavy, or maximum duty depending

on their performance in categories of impulse life, maximum surge impulse and 60 Hz current carrying capacity as specified in REA TE&CM 823. The gas modules shall be fail-short and shall shunt high voltage to ground in less than 100 microseconds, shall have an external spark gap, and shall comply with UL 497.

### 2.2.3 Fiber Optic Patch Panel

The patch panel shall provide a location for maintenance and cross-connecting of fiber optic cables. The panel shall have connectors which interface the inside plant fiber optic jumper cable with the outside plant fiber optic cable. Panels shall be equipped with engraved laminated plastic nameplates above each connector.

## 2.3 CABLE

### 2.3.1 Copper Conductor Cable

Copper conductor cable shall conform to the following:

#### 2.3.1.1 NOT USED

#### 2.3.1.2 Direct Buried

REA PE-39 for cable smaller than 400 pair.

#### 2.3.1.3 Underground

REA PE-39 for cable smaller than 400 pair.

### 2.3.2 Fiber Optic Cable

Reeled fiber optic cable shall contain 72 or 12 fibers as indicated on drawings and shall be of continuous manufacture with no factory splices in the fiber.

#### 2.3.2.1 Compatible Components

Materials used within a given cable shall be compatible with all other materials used in the same cable when such materials come into intimate contact. All cable components used shall have no adverse affect on optical transmission or on the mechanical integrity characteristics of the fiber placed in the cable. All materials used shall be nontoxic, noncorrosive, and shall present no dermal hazard. The minimum required material components applied to fiber optic cable construction are central core or sheath strength member, color-coded optical fibers, inner jacket, pulling strength members, and outer jacket.

#### 2.3.2.2 Cable Cores

A central core member shall be included to serve as a cable core foundation to reduce strain on the fibers but not to serve as a pulling strength member. The material of the central core member shall be nonmetallic. The nonmetallic strength element shall be glass filament.

#### 2.3.2.3 Optical Fiber

Single mode optical fibers shall be contained in the cable. The single-mode fiber shall be step index optical glass. The core diameter, if an addressable parameter, shall be 8.5 plus or minus 2 microns. If the core diameter is not addressed, then the mode field diameter shall be 10 microns plus or minus 1 micron. The cladding diameter shall be 125 microns plus or minus 5 microns. The core-cladding offset shall be less than 1 micron. The minimum tensile strength



of the fiber after primary protective coating shall be greater than 50,000 psi. The softening point of the clad material of the optical fiber shall be 1630 degrees C plus or minus 50 degrees C in compliance with ASTM C 338.

#### 2.3.2.4 Optical Fiber Coatings

The optical fiber shall be coated with a suitable material to preserve the intrinsic high tensile strength of the glass fiber. The outside diameter of the coated optical fiber shall be 250 microns plus or minus 15 microns. The coating material shall be readily removable, mechanically or chemically, without damaging the optical fibers when the removal is desired.

#### 2.3.2.5 Color Coding

The primary protective coated fiber shall be coated with a color-code coating for individual fiber identification. The maximum outside diameter of color-code coated fiber shall be less than 300 microns.

#### 2.3.2.6 Fiber Protection

The color-code coated fibers shall be surrounded with either loose buffer tubes, channels or other innovative design, or in a tight buffer construction, for protection from external mechanical and environmental influences. The interior of the tube shall be filled with a suitable gel-filling compound to prevent water migration. The loose tube buffering, channel or other innovative design, or tight buffer construction, shall be color coded for the tube identification. The material of the buffering tube shall be PVC, mylar, nylon, or a functionally equivalent material.

#### 2.3.2.7 Tint Requirements

The color concentrates or tints used to color the optical fibers and the buffer tubes shall not be susceptible to migration and chemical reaction with gel-filling compound.

#### 2.3.2.8 Buffer Tubes

The buffer tubes shall be located concentrically around the cable central core member and covered with a black, low or medium density polyethylene inner jacket in accordance with ICEA S-56-434.

#### 2.3.2.9 Filling Compound Requirements

The inner jacket interior and buffer cavity shall contain a gel-type filling compound. The filling compound shall be of suitable viscosity so that it shall protect the optical fibers against the ingress of water and/or soluble chemicals and shall not flow at the temperature of up to 65 degrees C. The gel-filling compound shall be colorless, electrically nonconducting, inert gel-type, waterproof, nontoxic, with no dermal hazards, and compatible chemically and mechanically with all cable components and associated splice hardware materials to which it may make contact. The gel filling shall be removable, as required, using commercially available products under field conditions.

#### 2.3.2.10 Tensile Strength

The cable shall contain a nonconductive central strength member as well as a layer of aramid type yarn encircling the cable core. The strength member shall provide a maximum pulling load of 1335 Newtons.

#### 2.3.2.11 Outer Jacket

Black, low or medium density, high-molecular weight, polyethylene materials shall be applied longitudinally over all the inner jacket and sheathing strength member to form the cable outer jacket, in accordance with ICEA S-56-434. The outer jacket shall be smooth, concentric, non-nutrient to fungus, and free from holes, splits, blisters, or other imperfections. The overall outside cable diameter shall not exceed 0.75 inch.

#### 2.3.2.12 NOT USED

#### 2.3.2.13 Fiber Differentiation

The individual optical fiber shall be easily and positively identified from the buffer tube color code and the optical fiber primary coating color code.

#### 2.3.2.14 Cable Labeling

The outer jacket shall bear the manufacturer's name, year of manufacture, and length marker. The length marking shall employ continuous four- or five-digit number in meters, such as:

Manufacturer's Name - Year  
XXXX meter

The markings shall be repeated clearly and distinguishably, on every meter on the cable outer jacket. The marking ink shall be fully compatible with the jacket material, nonsmearing, nonwater soluble, abrasion resistant, and durable enough to withstand field handling during placement and subsequent operations.

#### 2.3.2.15 Attenuation

The optical attenuation of each optical fiber in the reeled cable shall be no greater than 1.0 dB/km within a peak emissive region of 850 to 1300 nm. The attenuation shall be measured on completed cable reel length, and normalized linearly to 1 km. The measurement method shall be in accordance with EIA 455-46A or EIA 455-53A.

#### 2.3.2.16 Bandwidth

Each optic fiber within the cable (reeled) shall have its bandwidth measured between 3 dB optical power points, as compared to a reference signal, for a light source with a peak optical emissive region of 850 to 1300 nm. The effective system bandwidth of at least 1 GHz-km is required. The effective system bandwidth is the bandwidth length product calculated from the measured bandwidth multiplied by the cable length raised to the negative length dependance factor (or gamma factor). Gamma shall be in the range of 0.85 to 0.9. The bandwidth measurement shall be in accordance with EIA 455-54A FOTP-30 frequency domain or EIA 455-51A time domain.

#### 2.3.2.17 Numerical Aperture

The numerical aperture of each optical fiber shall be 0.2 plus or minus 0.02 within an optical emissive region of 850 to 1300 nm. The method of numerical aperture measurement shall be in accordance with EIA 455-47A.

#### 2.3.2.18 Bending Tolerance

The cable shall be able to withstand bending to a minimum radius of ten times the cable outer diameter with no tensile load applied, and of twenty times the cable outer diameter with maximum tensile load applied during installation, without

damage to cable components or degradation of the optical fiber performance at room temperature.

#### 2.3.2.19 Tensile Load Tolerance

The fiber optic cable shall withstand a pull force of at least 1780 Newtons, to be applied to the pulling strength member during the installation and a tensile load of at least 300 Newtons during operation without incurring any damage or detriment to fiber optic cable and optical performance. The tensile strength test shall be per EIA 455-54A FOTP-33.

#### 2.3.2.20 Cyclic Flexing Tolerance

The fiber optic cable shall withstand at least twenty bending cycles at minimum bend radius without damage to the fiber optic cable components or degrading optical performance. The cyclic flexing test shall be in accordance with EIA 455-65.

#### 2.3.2.21 Crush Resistance

The minimum crush resistance of the fiber optical cable shall be greater than 650 Newton/cm without damage to cable components or degrading optical performance. The crush resistance test shall be in accordance with EIA 455-41.

#### 2.3.2.22 Impact Resistance

The fiber optic cable shall be capable of withstanding twenty impacts, at a force of 5 Newtons-meters, without damage to cable components, or degradation of optical performance. The impact resistance test shall be in accordance with EIA 455-25A FOTP-25.

#### 2.3.2.23 Gel Compound Temperature Tolerance

The optic cable shall be tested for the ability of the gel-filling compound in the interior of the inner jacket and buffer to resist flow at the temperature range of minus 40 degrees C to 60 degrees C in accordance with EIA 455-81A.

#### 2.3.2.24 Fluid Penetration Test

The optic cable shall be capable of preventing the entry and axial migration of 9 psi pressurized water when subjected to fluid penetration testing in accordance with EIA 455-54A FOTP-82.

#### 2.3.2.25 Performance Requirements

The fiber optic cable shall comply with the mechanical performance requirements herein while used in duct applications where the temperature varies minus 20 degrees C to plus 60 degrees C. Optical performance degradation shall be less than 5 percent of the optical performance requirements in the temperature range of minus 20 degrees C to plus 60 degrees C. The fiber optic cable shall not be damaged in storage where the temperature may vary from minus 40 degrees C to plus 65 degrees C.

#### 2.3.2.26 Defects and Imperfections

Fiber optic cables shall be free of material and manufacturing defects, and of dimensional nonuniformities which would seriously impair the functionality of the cables. The fiber optic cables shall also be free from surface imperfections and internal defects which would prevent them from meeting the mechanical and transmission requirements of this specification.

#### 2.4 CONDUIT

Conduit as specified in Section C-16415 ELECTRICAL WORK, INTERIOR and Section C-16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and as shown shall be furnished.

#### 2.5 INNERDUCT

Innerduct shall be SDR 11.5 polyethylene plastic pipe conforming to ASTM D 2239.

#### 2.6 CLOSURES

##### 2.6.1 Copper Conductor Closures

###### 2.6.1.1 NOT USED

###### 2.6.1.2 NOT USED

###### 2.6.1.3 Underground

The underground closure shall be suitable to house a straight, butt, and branch splice in a protective housing into which can be poured an encapsulating compound. The closure shall be of suitable stainless steel preformed material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. The encapsulating compound shall be reenterable and shall not alter the chemical stability of the closure. Filled splice cases shall comply with REA PE-74.

##### 2.6.2 Fiber Optic Closures

###### 2.6.2.1 Omitted

###### 2.6.2.2 Omitted

###### 2.6.2.3 Underground

The underground closure shall be suitable to house a splicer organizer in a protective housing into which can be poured an encapsulating compound. The closure shall be of suitable stainless steel preformed material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. The encapsulating compound shall be re-enterable and shall not alter the chemical stability of the closure.

## 2.7 CABLE TERMINALS

### 2.7.1 NOT USED

### 2.7.2 Cross-Connect Cable Terminal

Cross-connect cable terminals shall be weatherproofed for outdoor use and suitable for pole, pad, or stake mounting. The terminal shall be equipped with mounting columns and distribution rings for jumper-wire routing. The terminal shall be of aluminum or steel construction and ribbed for strength.

## 2.8 CABLE SPLICES, CONNECTORS, CABLE ASSEMBLIES, AND ORGANIZERS

### 2.8.1 Copper Cable Splices

Copper cable splices shall consist of a moisture resistant, two- or three-wire connector held rigidly in place to assure maximum continuity. The correct connector size shall be used to accommodate the cable gauge of the cable to be supplied. The connectors used shall be listed in REA Bulletin 1755I-100.

### 2.8.2 Fiber Optic Cable Splices

Fiber optic cable splices shall consist of a fusion splice where two fibers are thermally fused together forming a continuous fiber length.

### 2.8.3 Pre-Connectorized Single Fiber Cable Assembly

Fiber cable connectors shall be the biconical ST type, field installable, self-aligning, and self-centering. The connectors shall be terminated on a 10-foot length of single-fiber cable. The single-fiber cable shall contain a buffered optical fiber of the same type and specification as that used in the multi-fiber cable.

### 2.8.4 Fiber Optic Splice Organizer

The splice organizer shall be suitable for housing fiber optic mechanical splices in a neat and orderly fashion. The closure shall allow for a minimum of one meter of cable to be neatly stored without kinks or twists. The splice organizer in the closure shall provide individual strain relief for each splice. The case shall be suitable for reentry, if required for future maintenance or modification, without damage to the cable or splices. All required splice organizer hardware, such as splice trays, protective glass shelves, and shield bond connectors shall be provided in the organizer kit.

## 2.9 MISCELLANEOUS ITEMS

### 2.9.1 Shield Connectors

Shield connectors shall make a stable, low-impedance electrical connection between the shield of the communications cable and a conductor such as a strap, bar, or wire. The connector shall be made of tin-plated tempered brass. Shield bond connectors shall comply with REA PE-33.

### 2.9.2 Grounding Braid

Grounding braid shall provide low electrical impedance connections for dependable shield bonding. The braid shall be made from flat tin-plated copper.

### 2.9.3 NOT USED

#### 2.9.4 NOT USED

### PART 3 EXECUTION

#### 3.1 INSTALLATION

All system components and appurtenances shall be installed in accordance with the manufacturer's instructions and as shown. All necessary interconnections, services, and adjustments required for a complete and operable telephone system shall be provided. All installation work must be done in accordance with the safety requirements set forth in the general requirements of ANSI C2 and NFPA 70.

##### 3.1.1 NOT USED

##### 3.1.2 Underground Cable

Underground cable installation shall be accomplished in accordance with the requirements set forth in REA TE&CM 644.

For cable installed in ducts and conduit, a cable feeder guide shall be used between the cable reel, and the face of the duct and conduit to protect the cable and guide it into the duct and conduit as it is paid off the reel. As the cable is paid off the reel, it shall be inspected for jacket defects. Precautions shall be taken during installation to prevent the cable from being kinked or crushed. A pulling eye shall be attached to the cable and used to pull the cable through the duct and conduit system. Cable shall be hand fed and guided through each manhole. As the cable is paid off the reel into the cablefeeder guide, it shall be sufficiently lubricated with a type of lubricant recommended by the cable manufacturer. Where the cable is pulled through a manhole, additional lubricant shall be applied at all intermediate manholes. Dynamometers or load-tension instruments shall be used to ensure that the pulling line tension does not exceed the installation tension value specified by the cable manufacturer. The mechanical stress placed upon a cable during installation shall not be such that the cable is twisted or stretched.

##### 3.1.3 NOT USED

##### 3.1.4 Innerduct

Innerduct shall be pulled through existing duct-manhole system in continuous sections. Splices, joints, couplings, or connections of any type will not be allowed between manholes. Innerduct shall be sealed with polyurethane foam duct seal. This material shall be inserted between the innerduct and the duct. In those innerducts in which cables are placed this material shall also be inserted between the cable and the innerduct. Only one cable shall be installed in a given innerduct. Existing and new unoccupied innerducts shall be trimmed leaving 2 inches exposed.

##### 3.1.5 Surge Protection

All cables and conductors, except fiber optic cable, which serve as communication lines through off-premise lines, shall have surge protection installed at each end which meet the requirements of REA PE-60.

#### 3.2 SPLICING

##### 3.2.1 Copper Conductor Splices

Copper conductor cable splicing shall be accomplished in accordance with REA PC-2.

### 3.2.2 Fiber Optic Splices

Fiber optic splicing shall be in accordance with the manufacturer's recommendation and shall exhibit an insertion loss not greater than 0.2 dB for fusion splices.

## 3.3 GROUNDING

Except where specifically indicated otherwise, all exposed noncurrent carrying metallic parts of telephone equipment, cable sheaths, cable splices, and terminals shall be grounded.

### 3.3.1 Master Ground Bar (MGB)

The Contractor shall provide a copper MGB which shall be the hub of the basic grounding system providing a common point of connection for ground from outside cable, MDF, and equipment. The Contractor shall establish a MGB to ground resistance, including ground, of 5 ohms or less.

### 3.3.2 Incoming Outside Plant Cables

#### 3.3.2.1 Cable Entrance Ground Bar

The Contractor shall provide a Cable Entrance Ground Bar (CEGB) to which all incoming outside plant cable shields shall be bonded directly. The CEGB shall be a copper ground bar provided for the purpose of terminating incoming telephone cable shields on a common connector point. The CEGB shall be connected to the MGB by the most direct route utilizing a copper wire conductor with a total resistance of less than 0.01 ohms.

#### 3.3.2.2 Building Distribution Frame Ground Bar

All shields of cable stubs to connector block shall be bonded to the Building Distribution Frame Ground Bar (BDFB). The BDFB shall be established by the Contractor and shall consist of a copper ground bar at the bottom of the BDF used as the connection point for the cable stud shields to connector blocks and BDF protector assemblies.

#### 3.3.2.3 Shields

The shields of all incoming cables shall not be bonded across the splice to the cable stubs. The shields of the incoming cables shall be grounded in the vault.

### 3.3.3 Building Distribution Frame Grounding

#### 3.3.3.1 Protection Assemblies

The BDF protector assemblies shall be mounted directly on the frame. The assemblies mounted on each frame shall be connected with a No. 6 AWG copper conductor to provide a low resistance path to the BDFB.

#### 3.3.3.2 MGB Connection

The BDFB shall be connected to the MGB by a copper wire conductor with a total resistance of less than 0.01 total Ohms.

#### 3.3.4 Manholes

The shields of all cables in each manhole shall be bonded together by a bonding wire or ribbon. At intermediate manholes where the cable is pulled through without a sheath opening, bonds are not required. If the manhole has a lacerating bonding ribbon, the shields of cable shall be attached to it.

### 3.4 ACCEPTANCE TESTS

The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all required testing. Notification of any planned testing shall be given to the Contracting Officer at least 14 days prior to any test, and in no case shall notice be given until after the Contractor has received written Contracting Officer approval of the test plans as specified. The test plans shall define all the tests required to ensure that the system meets technical, operational, and performance specifications. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested.

#### 3.4.1 Copper Conductor Cable

The following acceptance tests shall be performed in accordance with REA PC-4:

- a. Shield continuity.
- b. Conductor continuity.
- c. Conductor insulation resistance.
- d. Cable insertion loss and loss margin at carrier frequencies.
- e. Shield ground for single jacketed cables.
- f. DC loop resistance.

#### 3.4.2 Fiber Optic Cable

Three optical tests shall be performed: Optical Time Domain Reflectometry (OTDR) Test, Attenuation Test, and Bandwidth Test. These tests shall be performed on the completed end-to-end spans which include the near-end pre-connectorized single-fiber cable assembly, outside plant as specified, and the far-end pre-connectorized single-fiber cable assembly. The following acceptance tests shall be performed for each fiber in the completed cable length. Single-mode fibers do not require Bandwidth Test.

##### 3.4.2.1 OTDR Test

The OTDR test shall be used to determine the adequacy of the cable installations. The OTDR tests will show any irregularities, such as discontinuities, micro-bendings, improper splices, for the cable span under test. Hardcopy fiber signature records shall be obtained from the OTDR for each fiber in each span and shall be included in the test results. The OTDR test shall be measured in both directions. A reference length of fiber, 1 km minimum, used as the delay line shall be placed before the new end connector and after the far end patch panel connectors for inspection of connector signature.



#### 3.4.2.2 Attenuation Test

End-to-end attenuation measurements shall be made on all fibers, in both directions, using a 1300 nanometer light source at one end and the optical power meter on the other end. These tests will be used to verify that the cable system attenuation requirements are met. The measurement method shall be in accordance with EIA 455-53A.

#### 3.4.2.3 Bandwidth Test

The end-to-end bandwidth of all multimode fiber span links shall be measured by the frequency domain method. The bandwidth shall be measured in both directions on all fibers. The bandwidth measurements shall be in accordance with EIA 455-54A FOTP-30.

### 3.5 QUALIFICATION OF INSTALLERS

Telecommunications/information system equipments shall be installed by an experienced installer regularly engaged in the installation of telephone and fiber optic systems. The Contracting Officer may reject a proposed installer who can not show evidence of such qualifications.

-- End of Section --

## SECTION C-16770

### RADIO AND PUBLIC ADDRESS SYSTEMS

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA 310-C (1992) Racks, Panels and  
Associated Equipment

##### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

##### 1.2 SYSTEM DESCRIPTION

The radio and public address system shall consist of an audio distribution network to include amplifiers, mixers, microphones, speakers, cabling, and any ancillary components required to meet the required system configuration and operation.

###### 1.2.1 NOT USED

###### 1.2.2 NOT USED

###### 1.2.3 Single Channel System

The system shall control and amplify an audio program for distribution within the areas indicated. Components of the system shall include a mixer-amplifier, input for telephone, speaker system, cabling, and other associated hardware.

###### 1.2.4 System Performance

The system shall provide even sound distribution throughout the designated area, plus or minus 3 dB for the 1-octave band centered at 4000 Hz. The system shall provide uniform frequency response throughout the designated area, plus or minus 3 dB as measured with 1/3-octave bands of pink noise at locations across the designated area selected by the Contracting Officer. The system shall be capable of delivering 75 dB average program level with additional 10 dB peaking margin sound pressure level (SPL) to any location in the area at an acoustic distortion level below 5 percent total harmonic distortion (THD). Unless otherwise specified the sound pressure reference level is 20 micro Pascal (0.00002 Newtons per square meter).

##### 1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

SD-01 Data

Spare Parts; FIO.

Spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than 3 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

#### SD-04 Drawings

Radio and Public Address System; GA.

Detail drawings consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Detail drawings shall also contain complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

#### SD-09 Reports

Test Plan; GA.

Test plan and test procedures for the acceptance tests. The test plan and test procedures shall explain in detail, step-by-step actions and expected results to demonstrate compliance with the requirements specified. The procedure shall also explain methods for simulating the necessary conditions of operation to demonstrate system performance.

Acceptance Tests; FIO.

Test reports in booklet form showing all field tests performed to adjust each component and to prove compliance with the specified performance criteria, upon completion and testing of the installed system. The reports shall include the manufacturer, model number, and serial number of test equipment used in each test. Each report shall indicate the final position of controls and operating mode of the system.

#### SD-19 Operation and Maintenance Manuals

Radio and Public Address System; FIO.

Six copies of the operation manual outlining the step-by-step procedures required for system start up, operation, and shutdown. The manual shall include equipment layout and schematics of simplified wiring and control diagrams of the system as installed, the manufacturer's name, model number, and brief description of all equipment and their basic operating features. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The manual shall include equipment layout and schematics and simplified wiring and control diagrams of the system.

#### 1.4 DELIVERY AND STORAGE

Equipment placed in storage until installation time shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

#### 1.5 VERIFICATION OF DIMENSIONS

The Contractor shall become familiar with the details of the work and working conditions, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancies before performing the work.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

Material and equipment to be provided shall be the standard products of a manufacturer regularly engaged in the manufacture of such products, and shall essentially duplicate material and equipment that have been in satisfactory use at least 2 years. All components used in the system shall be commercial designs that comply with the requirements specified. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

#### 2.1.1 Identical Items

Items of the same classification shall be identical. This requirement includes equipment, modules, assemblies, parts, and components.

#### 2.1.2 Nameplates

Each major component of equipment shall have the manufacturer's name, address, model and catalog number, and serial number on a plate secured to the equipment.

### 2.2 NOT USED

### 2.3 NOT USED

### 2.4 MIXER AMPLIFIER

Mixer amplifier shall as a minimum conform to the following specifications:

Rated Power Output:	35 watts RMS
Frequency Response:	Plus or Minus 2 dB, 60-13,000 Hz
Distortion:	Less than 1 percent at RPO, 60 - 13,000 Hz
Inputs:	2 microphones (high impedance or low-impedance unbalanced) 2 Aux. (high-impedance)
Output Impedance:	Balanced 4, 8, and 16 ohms
Output Voltage:	25 and 70 volts
Power Requirement:	110-125 Vac 60 Hz

### 2.5 NOT USED

### 2.6 NOT USED

### 2.7 LOUDSPEAKERS

#### 2.7.1 Cone Speaker

The cone speaker shall be used in all locations except maintenance bays and as a minimum conform to the following specifications:

Application:	Wall baffle
Frequency range:	60 to 12,000 Hz

Power Rating:	Normal - 7 watts Peak - 10 watts
Voice Coil Impedance:	8 ohms
Line Matching Transformer Type:	25/70 volt line
Capacity:	2 watts
Magnet:	8 ounces or greater
Primary Taps:	0.5, 1, and 2 watts
Primary Impedance:	25 volts - 1250, 625, and 312 ohms 70 volts - 10k, 5k, and 2.5k ohms
Frequency Response:	30 - 20,000 Hz
Insertion Loss:	Less than 1 dB

#### 2.7.2 Horn Speaker

The horn speaker shall be used in maintenance bays and as a minimum conform to the following specifications:

Application:	Indoor
Frequency Response:	400 - 14,000 Hz
Power Taps:	70 volt line - .9, 1.8, 3.8, 7.5, and 15 watts
Impedance:	5000, 2500, 1300, 670, 330, 90, and 45 ohms
Power Rating:	Normal - 7 watts Peak - 15 watts

#### 2.7.3 Speaker Enclosures

Wall baffle or column speaker enclosures shall be of the tuned-port design for precise balancing and tuning of the speaker. The enclosures shall be constructed throughout of 3/4 inch, high density board, with screwed and glued joints, durably braced, and padded with fiberglass where acoustically required. For wall mounting applications, the wall baffle enclosure shall come equipped with a wall-mounting bracket designed to assure a rigid mounting to any flat surfaces. Column speaker enclosures shall have a 45 degree vertical dispersion and 120 degrees horizontal dispersion. The effective length of throw shall be a minimum of 50 feet.

2.8 NOT USED

2.9 NOT USED

2.10 NOT USED

2.11 NOT USED

2.12 NOT USED

### 2.13 PRIORITY RELAYS AND CONTROLS

Priority relays and controls required to accomplish operations specified shall be provided. Relays shall be completely enclosed with a plastic dust cover for maximum protection against foreign matter, and shall be plug-in type. Relays shall be provided with a diode wired across the relay coil for transient suppression and shall be installed utilizing factory-prewired, rack-mounted receptacle strips. Coil shall be maximum 24 volts dc.

### 2.14 NOT USED

### 2.15 EQUIPMENT RACKS

Equipment shall be mounted on 19-inch racks in accordance with EIA 310-C and located as shown on drawings. Ventilated rear panels, solid side panels, and solid top panels shall be provided. Perforations or louvers may be provided in front panels to ensure adequate ventilation of equipment. The racks and panels shall be factory finished with a uniform baked enamel over rust inhibiting primer.

### 2.16 SPEAKER AND MICROPHONE CABLE

Cables shall be of the gauge required depending upon the cable run length. In no case shall any cable be used which is smaller than 20 AWG. Insulation on the conductors shall be polyvinyl chloride (PVC) or an equivalent synthetic thermoplastic not less than .009 inch. Cables shall be shielded with a 34-gauge tinned soft copper strand formed into a braid. Cables shall be jacketed with a PVC compound. The jacket thickness shall be 0.0200 inch minimum.

### 2.17 POWER SURGE PROTECTION

Major components of the system such as power amplifiers, mixer-amplifiers shall have a device, whether internal or external, which provides protection against voltage spikes and current surges originating from commercial power sources.

### 2.18 SIGNAL SURGE PROTECTION

Major components of the system shall have internal protection circuits which protects the component from mismatched loads, direct current, and shorted output lines.

## PART 3 EXECUTION

### 3.1 INSTALLATION

All equipment shall be installed as indicated and specified, and in accordance with the manufacturer's recommendations except where otherwise indicated. Equipment mounted out-of-doors or subject to inclement conditions shall be weatherproofed.

#### 3.1.1 Equipment Racks

Racks shall be mounted side-by-side and bolted together. Items of the same function shall be grouped together, either vertically or side-by-side. Controls shall be symmetrically arranged at a height as shown. Audio input and interconnections shall be made with approved shielded cable and plug connectors; output connections may be screw terminal type. All connections to power supplies shall utilize standard male plug and female receptacle connectors with the female receptacle being the source side of the connection. Inputs, outputs, interconnections, test points, and relays shall be accessible at the rear of the equipment rack for maintenance and testing. Each item shall be removable from

the rack without disturbing other items or connections. Empty space in equipment racks shall be covered by blank panels so that the entire front of the rack is occupied by panels.

### 3.1.2 Wiring

Wiring shall be installed in rigid conduit, intermediate metal conduit, cable trays, or electric metallic tubing as specified in Section C-16415 ELECTRICAL WORK, INTERIOR. Wiring for microphone, grounding, line level, video, speaker and power cables shall be isolated from each other by physical isolation and metallical shielding. Shielding shall be terminated at only one end.

### 3.2 GROUNDING

All grounding practices shall comply with NFPA 70. The antenna mast shall be separately grounded. The system shall utilize a multiple-point signal grounding scheme where conductive path connections are required between each piece of equipment and the reference ground point. An isolated ground bar for power shall be provided for the connection of the main system components. The ground bar shall be connected to the main service ground utilizing a No. 6 conductor.

### 3.3 ACCEPTANCE TESTS

After installation has been completed, the Contractor shall conduct acceptance tests, utilizing the approved test procedures, to demonstrate that equipment operates in accordance with specification requirements. The Contractor shall notify the Contracting Officer 7 days prior to the performance of tests. In no case shall notice be given until after the Contractor has received written Contracting Officer approval of the test plans as specified. The acceptance tests shall include originating and receiving messages at specified stations, at proper volume levels, without cross talk or noise from other links or nondesignated units.

### 3.4 TRAINING

The Contractor shall conduct a training course for 3 members of the operating and maintenance staff as designated by the Contracting Officer. The training course will be given at the installation during normal working hours for a total of 4 hours and shall start after the system is functionally complete but prior to final acceptance tests. The field instructions shall cover all of the items contained in the approved operating and maintenance manuals, as well as demonstrations of routine maintenance operations. The Contracting Officer shall be notified at least 14 days prior to the start of the training course.

-- End of Section --

## SECTION 16855

### ELECTRIC SPACE HEATING EQUIPMENT

#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

##### AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 210 (1985) Laboratory Methods of Testing Fans for Rating

AMCA 300 (1985; Rev 1987) Reverberant Room Method for Sound Testing of Fans

##### AMERICAN SOCIETY OF HEATING, REFRIGERATION AND AIR CONDITIONING ENGINEERS (ASHRAE)

ASHRAE-06 (1992) HVAC Systems and Equipment - I-P Edition

##### COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1419 (Rev A) Filter Element, Air Conditioning (Viscous-Impingement and Dry Types Replaceable)

##### NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6 (1988; Rev 1) Enclosures for Industrial Control and Systems

##### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

##### UNDERWRITERS LABORATORIES (UL)

UL 1025 (1980; Rev thru Feb 1990) Electric Air Heaters

UL 1042 (1987) Electric Baseboard Heating Equipment

##### 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section C-01330 SUBMITTAL PROCEDURES:

##### SD-04 Drawings

Heating Equipment; FIO.

Detail drawings consisting of a complete list of equipment and material, manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Detail drawings shall consist of a control schematic, complete power and control wiring diagrams, device ratings, part numbers and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. A nameplate drawing shall be included, with details of the type, size, and material of proposed nameplates, method recommended for fastening to the mounting surfaces,



and raised or engraving details proposed. Nameplates shall be identified by number. Location of nameplates shall be shown on equipment arrangement drawings, with the nameplate number, and on wiring diagrams where devices or items of equipment appear.

### 1.3 STANDARD PRODUCTS

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. The experience use shall include applications of equipment and materials under similar circumstances and of typical design and rating. Equipment items provided shall be capable of being serviced by an organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

### 1.4 NAMEPLATES

A nameplate, not smaller than 1-by 4-inches and raised or engraved with not less than 1/4-inch characters, shall be mounted on the front of the enclosure to adequately identify the space heater assembly. Fans and motors shall have the manufacturer's name, address, type or style, model or serial number and catalog number on a plate secured to the item of equipment.

### 1.5 CODES

Unless otherwise specified all work shall be in accordance with NFPA 70.

### 1.6 MANUFACTURER'S SERVICES

The Contractor shall obtain the services of the manufacturer's representative experienced in the installation, adjustment and operation of the equipment specified. The representative shall supervise the installation, adjustment and testing of the equipment.

### 1.7 DELIVERY AND STORAGE

Equipment placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust or other contaminants.

## PART 2 PRODUCTS

### 2.1 NOT USED

### 2.2 UNIT HEATERS (HORIZONTAL PROPELLER FAN TYPE)

#### 2.2.1 Construction

Unit heaters shall have wattage, voltage, phase, Btu/hr output, cfm air delivery, number of steps, and mounting height as shown or as specified. Complete unit heater assembly shall comply with the requirements of UL 1025 and the requirements specified. Each unit heater shall be provided with terminals for control circuits and a single source of power as necessary. Control transformers, where required, shall be factory installed and of adequate capacity. Maximum discharge air temperature shall not exceed 140 degrees F when inlet air temperature is 60 degrees F.

#### 2.2.2 Heating Elements

Heating elements shall consist of nickel-chromium heating wire embedded in magnesium-oxide insulating refractory and sealed in corrosion-resisting metallic sheath with fins. The ends of elements shall be sealed and enclosed in terminal box, and element sheath shall be mechanically pressed after filling to ensure

maximum magnesium oxide compaction. Sheath and fins shall be cast aluminum or steel with fins brazed to sheath. Castings shall be free from defects of any nature. Steel sheath and fins shall be corrosion protected by copper plating. Heat transfer between sheath and fins shall be uniform. Fins shall be spaced a maximum of six per inch and fin surface temperature at any point shall not exceed 550 degrees F during normal operation. Elements shall be free from expansion noise and 60-cycle hum.

#### 2.2.3 Enclosure

Heater fan, motor, and auxiliaries shall be contained in a housing. All metal surfaces of housing shall be not less than 18 US gauge. Housings shall have the manufacturer's standard factory baked enamel finish. All parts shall be rigidly braced with heavy steel plates or structural steel shapes to prevent vibration and maintain alignment. Housing design shall provide ready access to interior parts without unfastening housing from mounting bracket. Swivel mounting brackets shall be furnished with each heater for wall or ceiling mounting as indicated. Each unit heater shall develop the floor area coverage and air throw required by the heater layout shown. The floor area coverage and air throw data shall be included on the detail drawing submittal.

#### 2.2.4 Louvers

Horizontal air discharge units shall have individually adjustable horizontal louvers to direct discharge air horizontally as desired. A louvered back, heavy grille, or wire guard shall be provided for inlet air. Vertical air discharge units shall be provided with individually adjustable louvers so that air-flow pattern can be adjusted in all directions.

#### 2.2.5 Fans and Motors

Fans shall be the propeller type direct connected to fan motor, dynamically balanced, and designed specifically for unit heater application and low noise level. Sleeve type bearings shall have ample provisions for lubrication and oil reservoir, and shall be effectively sealed against loss of lubrication and entrance of dirt. Ball and roller type bearings shall be sealed, self-aligning and permanently lubricated. Fan motor shall be totally enclosed, continuous duty with built-in manually reset thermal overload protection. Single-phase motors shall be permanent split capacitor, capacitor-start, or shaded pole type. Motor shall operate from the same power supply as the heater, and at the same voltage unless a factory-furnished step-down transformer is provided. Motor speed shall not exceed 1800 rpm.

#### 2.2.6 Limit Controls

Manual reset thermal overheat protection of unit shall be provided to protect against overheating of the unit and mounted in a convenient location.

#### 2.2.7 Contactor

Unit shall have factory-installed magnetic contactor, for remote thermostatic operation, which shall disconnect all ungrounded conductors to the heater. Contactor shall be rated for 100,000-cycle duty. A control transformer shall be provided when necessary to supply 120 volt thermostat control circuit for each heater.

#### 2.2.8 Remote Controls

Room thermostat for pilot duty shall be provided where shown. Thermostat shall have an approximate range of from 55 to 85 degrees F and an operating differential of 3 degrees F or less. A fused safety disconnect switch shall be provided in NEMA ICS 6, Type 1 enclosures and wall mounted 4 feet 6 inches above

floor near the heater or as shown. Control devices shall be connected to the unit heater with wire in conduit.

#### 2.2.9 Wiring

Heaters shall be furnished complete, factory prewired to terminal strips, ready to receive branch circuit and control connections.

2.3 NOT USED

2.4 NOT USED

2.5 NOT USED

2.6 NOT USED

### PART 3 EXECUTION

#### 3.1 HEATERS

Heaters shall be installed at the locations shown and in accordance with the recommendations of the manufacturer.

--End of Section--